Flora W. Patterson

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NOTES ON NEW YORK PLANT DISEASES, I.

F. C. STEWART.

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BULLETIN No. 328.

NOTES ON NEW YORK PLANT DISEASES, I.

F. C. STEWART.

SUMMARY.

This bulletin contains brief notes on various plant diseases and malformations observed in New York during the past ten years. The principal items are as follows: Bitter rot of apples is a rare disease in New York. Crown gall is an unimportant disease of apple trees. Double, and even triple, apples occur occasionally. Apple leaves affected with scab are particularly liable to spray injury. Apple rust (*Gymnosporangium* spp.) is practically unknown to New York fruit growers except in the Hudson valley and on Long Island. The powdery mildew attacking apples in New York is *Podosphæra leucotricha*. It is common in nurseries and sometimes occurs even on bearing trees in the orchard. The Florida San-José-scale fungus has been found on apple trees on Long Island. Veneer tree protectors may seriously injure apple-tree trunks if left on the trees continuously. The period of incubation for *Puccinia asparagi* is probably less than three weeks. On Long Island, string beans have been found attacked by powdery mildew.

The beech and other deciduous trees in the vicinity of Seventh Lake, Adirondack Mountains, are much injured by *Fomes igniarius* which causes heart-rot. *Fomes fomentarius* is exceedingly common in the same region. Sporophores of *F. fomentarius* often change their direction of growth owing to the falling of the trunk on which they are growing. Sometimes, *Fomes pinicola* occurs on beech and maple. *Cercospora beticola* may be transmitted with the seed of sugar beets. *Phyllosticta betæ* has been found on leaves of sugar beet at Flint. Begonia leaves are occasionally attacked by powdery mildew and eelworms. *Calyptospora*

goeppertiana occurs on species of Vaccinium in New York. Box-tree cuttings which fail to root are covered with *Phoma stictica.* The leaves of red cedar branches attacked by *Gymnosporangium nidus-avis* are like those on young trees; that is to say, the attack of the fungus brings about reversion to the juvenile form. *Sclerotinia fructigena,* in the Monilia stage, kills cherry blossoms and twigs. *Sclerotinia seaveri,* in its conidial stage, kills many leaves and twigs of *Prunus serotina. Exoascus cerasi* occurs occasionally on cultivated cherry trees, particularly on Long Island. The cherry Gov. Wood appears immune to *Podosphæra oxyacanthae. Cylindrosporium padi* may attack the fruit of *Prunus virginiana.* The spore masses of *Pilobolus crystallinus* on chrysanthemum and rose leaves have been misunderstood. *Erysiphe cichoracearum* has been found on a new host — *Coreopsis tinctoria.* Cosmos is attacked by powdery mildew and a serious stem blight caused by *Phomopsis stewartii.* Occasionally, cucumbers in the open are attacked by a powdery mildew. *Uncinula necator* sometimes grows along the mines of *Phyllocnistis vitigenella* on grape leaves. Contrary to the common belief, the mine of this insect is sub-epidermal. *Plasmopara pygmæa* is destructive to hepatica plants. According to Whetzel, the fungus perpetuates itself by a perennial mycelium as well as by oöspores. *Ascochyta parasitica* and *Septoria parasitica* are sometimes associated with *Puccinia malvacearum* on hollyhock leaves in such manner as to indicate that they are parasitic on the Puccinia. *Microsphæra alni* var. *lonicerae,* said by Salmon not to occur in America, has been found in abundance at Geneva on leaves of Tartarian honeysuckle. The English hop mold or mildew, *Sphaerotheca humuli,* occurred destructively at Waterville, Middleburgh and several other places in 1910. Some was found at Waterville, also in 1909. The comb-like raggedness of horse chestnut leaves, so common in New York, is caused by late spring frosts. Norway maple leaves show irregular holes due to the same cause. Sometimes large numbers of Norway maple leaves fall in June from the attack of aphids. *Rhytisma acerinum,* although common on *Acer rubrum* and *A. sacchar-*

inum, does not attack *A. platanoides* in New York. *Septoria cucurbitacearum* has been found on mushmelon leaves near Syracuse. *Albugo candidus* has been found on a new host — *Tropaeolum majus*. Oak spangle galls, caused by *Cynips poculum*, strikingly resemble certain Discomycetous fungi. It seems very doubtful if the reddening of young oat leaves, as it occurs in New York, is of bacterial origin as claimed by Manns. A puzzling case of œdema on pear trees was observed in a nursery store-house at Rochester. In a Long Island orchard the leaves and fruit of Kieffer pears have been severely attacked by *Gymnosporangium globosum*. A pear grower of Kendaia has had much trouble from the failure of pear grafts caused by a canker which attacks the cut end of the stock. A new leaf disease of phlox caused by *Cercospora phlogina* has been found at Floral Park. In a nursery at Geneva, trees of the Compass plum were severely injured by the conidial stage of *Sclerotinia fructigena*, which killed the twigs and produced cankers on the trunks of the trees. In all cases, the fungus entered through the blossoms. Adjacent trees of other varieties, not blooming, were uninjured. The Corticium stage of the potato Rhizoctonia has been found on Long Island. Except on Long Island the Rhizoctonia disease of potatoes is not important in New York. There is no relation between the potato Rhizoctonia occurring in Colorado and New York and *Rhizoctonia violacea* which causes root-rot of alfalfa in Europe. Quince rust, *Gymnosporangium clavipes*, was unusually abundant in 1910. *Rhizoctonia* sp. causes damping off and rot of radishes in greenhouses. It has been proven, by means of artificial cultures, that *Leptosphaeria coniothyrium* is the ascogenous form of *Coniothyrium fuckelii*. Spores of *Leptosphaeria coniothyrium* on pieces of dead raspberry canes lying on the ground may retain their viability for four years. *Mycosphaerella rosigena* causes a leaf-spot disease of roses in greenhouses. *Sphaerotheca pannosa* produces perithecia on stems and leaves of roses in the open air, but not in greenhouses. In 1910, a rye field at Geneva was much infested with *Erysiphe graminis*. An undescribed disease, caused

by a species of Glœosporium, has attacked the leaves and berries of snowberry at Geneva. Two cases of powdery mildew on sweet peas were observed. Timothy heads showing proliferous flowers were abundant at Geneva in 1898. In the Station greenhouse tomato plants have shown leaves and shoots growing from flower clusters and leafy shoots growing from leaf-midribs. A new wilt disease of variegated vinca, caused by *Phoma* sp., was observed at Batavia. Wheat has been attacked by *Tilletia foetens, T. tritici* and *Septoria graminum.*

INTRODUCTION.

In the prosecution of Station investigations in plant pathology the members of the Botanical Department have opportunity for making numerous observations on a great variety of plant diseases in various parts of the State. Many of these observations, while too fragmentary for separate publication, are yet worthy of permanent record. Accordingly, we have decided to publish, from time to time, bulletins containing miscellaneous notes on plant diseases. The present bulletin is the first of the series. It is expected that these bulletins will contain, especially, notes on the occurrence, distribution and economic importance of the various diseases of economic plants in the State. For convenience in reference, all notes on the diseases of a particular plant are placed together and the host plants arranged alphabetically by their common names. It will be observed that many important diseases are not even mentioned. No attempt has been made to make a complete list of the plant diseases occurring in the State. Such a list would be useful and it is hoped that the proposed series of bulletins may furnish the data from which, some time, one may be compiled; but this first bulletin contains only such scattered notes as it seems worth while to publish at the present time.

In connection with this work, it is our intention to build up, gradually, a museum and herbarium of specimens representing as fully as may be possible the diseases of New York economic plants. All specimens which may be mounted on herbarium sheets will be preserved in that manner; while those unsuited

to the herbarium will be placed in cases. In the herbarium the arrangement will be by host plants; for example, the various peach diseases will be placed together in the same folder or series of folders. We shall call this the Host Herbarium to distinguish it from the regular Station herbarium. For the purposes of the plant pathologist, such an herbarium has two important features: First, it provides a place for filing specimens of diseases of non-parasitic origin, such as frost injury, and, also, undetermined diseases and those of unknown origin, such as peach yellows; second, it facilitates the comparison of the characters of the various diseases of a given host plant.

The specimens in the Host Herbarium and also those in the Museum will be numbered so that they may be referred to by number. Numerous such references will be found in the present bulletin. This is done in order that other investigators who may wish to examine the specimens upon which our statements are made may have no difficulty in identifying them.

ALFALFA.

Medicago sativa.

The various diseases affecting alfalfa in New York have been discussed in Bulletin No. 305.[1]

Downy mildew, *Peronospora trifoliorum* De By. In Bulletin 305, page 394, this fungus is reported to have occurred on alfalfa in five different localities in New York. In an alfalfa field on the Station farm it has occurred during four consecutive years — 1907–1910.

In July, 1909, it was more plentiful than at any other time, yet not sufficiently abundant to cause appreciable loss.[2]

Yellow top.[3] A well-marked case of this disease was observed at Fayetteville on September 17, 1909. In an alfalfa field, over

[1] To the list given in that bulletin should be added *Glœosporium medicaginis* E. & K. since reported by Peck (101, p. 21). The number in the parenthesis refers to the bibliography at the end of this bulletin.

[2] Host Herbarium Specimen No. 1.

[3] For a description of yellow top see Bulletin No. 305, p. 403.

the greater part of which the plants were quite normal in color, there was a semi-circular area of about one-fourth acre on which nearly all of the plants were green below and yellow at the top. In this case, the character of the soil seems to have been a factor. The affected area was near one end of the field on a knoll where the soil was somewhat different from that of the remainder of the field.

In the moister season of 1910 the disease did not reappear, indicating that weather conditions, also, have something to do with it.

Root-knot, *Heterodera radicicola* (Greeff) Müll.[4] In July, 1909, Mr. F. R. Stevens, an agent of the New York State Department of Agriculture, brought to the Station specimens of alfalfa roots affected with nematode root-knot. These specimens were taken in Madison County, but Mr. Stevens reports having seen the trouble in various parts of the State during the summer of 1909.

APPLE.

Pyrus malus.

Bitter rot, *Glomerella rufomaculans* (Berk.) Spaul. & von Schr. There appears to be a misapprehension concerning the extent of the damage done by the bitter rot fungus in New York.[5] von Schrenk and Spaulding's map showing the distribution of bitter rot in the United States would lead one to believe that the fungus is common and destructive in western New York.[6] Among New York fruit growers, also, this idea is not uncommon. The fact is, bitter rot of apples is rare in New York. It is of no economic importance whatever. The writer has taken the Gloeosporium stage (*G. fructigenum*) only once (at Geneva, in October, 1907) on apple fruit[7] and has never known it to attack apple branches in New York.

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[4] The occurrence of a nematode root-knot of alfalfa in New York was first reported in Bulletin No. 305, p. 401.

[5] Stewart (142, p. 84).

[6] von Schrenk and Spaulding (121, p. 13).

[7] Host Herbarium Specimen No. 2.

In reporting the results of a fruit-disease survey of western New York made in 1900 we made the following statement:[8] "Bitter rot, *Glœosporium fructigenum,* is reported to have been unusually common." Doubtless this was an error. We have since learned that what New York fruit growers call bitter rot is sometimes pink rot (*Cephalothecium roseum* Cda.) and sometimes the disease described by the writer[9] under the name of "fruit spot" which, according to Brooks,[10] should now be called fruit pit.

On our grapes, bitter rot occurs more frequently,[11] but even on that fruit it is of little economic importance in New York.

Crown gall, *Bacterium tumefaciens* Smith & Town. In New York, the so-called crown gall or root gall disease is common on apple trees as well as on several other woody plants.[12] In the mind of the planter the question naturally arises, What effect will the galls have on the future growth of the trees? During twelve years' acquaintance with apple diseases in New York the writer has never seen or known of a well authenticated case in which crown gall has injuriously affected apple trees in the orchard. The results of the following two experiments recently reported by the writer[13] tend to support the view that crown gall, as it affects the apple, is an unimportant disease in New York.[14] "In 1899, C. H. Stuart & Co., Newark N. Y., set out an experimental orchard of 500 trees, mostly Baldwins, all affected with crown gall. The trees have now been set nine years. Under date of January 20, 1908, Mr. Stuart writes as follows: 'The trees to-day show as good a growth as the trees planted the same time and free from crown gall. The bark is smooth, healthy in appearance, and the trees look thrifty and vigorous.' An experiment

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8 Stewart et al (152, p. 297).

9 Stewart (140, p. 216).

10 Brooks (15).

11 Southworth (135, p. 171); Lodeman (74, p. 448); Peck (96, p. 111); and Fairchild (34).

12 Bailey (12, p. 367); Stewart et al (152, p. 300).

13 Stewart (143, p. 98).

14 Hedgcock (59, p. 72) who has made an exhaustive study of crown gall states that the effect of crown gall upon apple trees in the orchard has been overrated.

made by the Station bears on this point. In 1901, we planted twenty-two apple trees affected with crown gall, to determine the effect of this disease upon the growth of the trees. The trees were three years old. The galls varied in size from one to two inches in diameter and were located mostly on the tap-root, but in a few cases on lateral roots. Some of the trees had several galls each. We believe the galls were typical of those commonly found on apple trees in New York nurseries. Five of the trees were dug in 1903, five in 1905 and the remainder in 1907. In no instance was there any evidence that the galls had increased in size or number, or that they had been in any way injurious to the trees. Probably apple trees bearing large galls should be rejected, but unaffected trees from the same lot may be planted without fear of bad results."

Leaf spot. In a recent discussion of apple leaf spot the writer made the following statements:[15] "Apple leaf spot, a disease which manifests itself in the form of circular, dead, brown spots on the leaves, is common and often destructive in New York apple orchards. For some years it has been known that such leaf-spotting is frequently due to bordeaux injury,[16] but there are also other causes not well understood. Scott and Rorer,[17] who have been making an investigation of apple leaf-spot in the Middle West, find that the disease, as it occurs there, is caused by *Sphæropsis malorum,* the fungus of apple canker and black rot. Concerning the nature of the disease which we have here in the East they say:[18] 'The common apple leaf-spot disease of the eastern states being so similar in every respect, is doubtless caused by the same fungus, although some other fungi may possibly produce similar spots.'

"Certainly, our orchards are full of the canker fungus, and since it has been proven that this fungus readily attacks apple leaves the above conclusion seems warranted. However, there is

15 Stewart (144).
16 Stewart and Eustace (150, pp. 225–233); Hedrick (60, p. 133).
17 Scott and Rorer (123).
18 Loc. cit. p. 52.

one fact opposed to this view, viz., in New York, spraying often fails to control leaf-spot.[19] Were the disease due to Sphæropsis it should be controllable by spraying here as readily as it is in Virginia and Missouri. We believe that the leaf-spot problem in New York is not yet completely solved."

Mr. F. A. Sirrine, Riverhead, Long Island, informs us that his apple orchard has been sprayed regularly since 1903 without any appreciable diminution of the leaf-spot, except in 1909, when it was considerably less affected than the unsprayed part of the same orchard owned by a neighbor. Each spring Mr. Sirrine's part of the orchard has been sprayed with lime-sulphur on the dormant wood for San José scale. In addition, one to three applications of bordeaux have been made after blooming; but in 1909 the regular application of lime-sulphur was followed with *four* applications of bordeaux — one before blooming and three after blooming.

In this connection it is worthy of note that *Sphæropsis malorum* rarely fruits on living apple leaves in New York.[20]

Myxosporium canker, *Myxosporium corticolum* Edgerton. This is the bark disease previously described by us under the name Macrophoma canker.[21] Following Paddock[22] we referred the associated fungus to *Macrophoma malorum* (Berk.) Berl. & Vogl., but Edgerton[23] has shown that it properly belongs in the genus Myxosporium and has described it under the name *Myxosporium corticolum*. He uses the common name bark canker. We think Myxosporium canker a better name. On the subject of the parasitism of the fungus we have nothing to add to previous publications. *Myxosporium corticolum* occurs also on the dead bark of pear trees affected with body blight.

Double and triple fruits: syncarpy. In November, 1906, Mr. J. B. Anderson, a Geneva fruit grower, brought us a double apple of the Baldwin variety. The two parts were about equal

[19] Stewart (139, p. 455); Stewart and Eustace (150, p. 230).

[20] The occurrence of *Sphæropsis malorum* on apple leaves in New York has been reported by Peck (94, p. 76) and Stewart et al (152, p. 298). It has been collected, also, by Prof. H. H. Whetzel at McLean, N. Y., June 30, 1906.

[21] Stewart et al (152, p. 298).

[22] Paddock (85, p. 203 and 86, p. 211).

[23] Edgerton (31).

in size (slightly under average size for the variety), they had a common stem, were well formed, and their core axes lay at right angles with the stem. Their general appearance was that of two apples slightly grown together at their stem ends.[24]

At a meeting of the Western New York Horticultural Society in January, 1908, a gentleman showed us a triple apple of the Russet variety.

In January, 1910, Mr. W. H. Alderman, Assistant Horticulturist, showed the writer a double apple, variety Moyer, grown on the Station grounds. In this specimen, the two fruits, although slightly unequal in size, were grown together so closely as to resemble a single apple somewhat flattened and with a groove extending down either side. The stem, which was about an inch long, was slightly flattened as if formed by the union of two stems. The core axes lay nearly parallel and at the tip of the fruit here were two separate calices about 20 mm. apart. (Plate I.)

The above are the only specimens coming under our personal observation, but it is said that double apples are not rare and triple apples, also, are occasionally found.

Masters[25] has described and figured double apples and mentions a figure of a triple apple by Schlotterbec. In the *Country Gentleman* for November 28, 1907, page 1123, there is a figure of a double apple which must have been very much like the Anderson specimen. In a later issue of the same paper[26] the horticultural editor writes as follows:

"Recent notes on siamism in apples, said by some authorities never or rarely to occur, have brought us a number of specimens, the latest being two pairs from Mr. George Beaumont of New Haven County, Conn., who says the tree produces a lot of these monstrosities annually, this year 'half a bushel' of them."

Such doubling of fruit is known as syncarpy. It is teratological rather than pathological. According to Sorauer,[27] double

[24] Museum Specimen No. 132.
[25] Masters (80, pp. 47, 48).
[26] *Country Gentleman* **73**: 178. Albany, N. Y. 20 F. 1908.
[27] Sorauer (134, p. 376); cfr. also, Frank (40, **3**:338).

fruits originate by the fusion of two separate lateral blossom primordia (blossom buds).

Scab, *Venturia inaequalis* (Cke.) Aderh. Early in June, 1909, we were informed that an unknown trouble had appeared in some of the apple orchards in the vicinity of Medina. Upon making a visit to the worst affected orchard it was found that the trouble was simply a bad case of apple scab combined with spray injury. The Baldwins were more affected than the Greenings, and the Russets least of all. There had been an early outbreak of scab, and as no spraying was done before blooming the fungus spread so rapidly that by the time the blossoms had fallen most of the leaves were more or less affected. About this time the orchard was sprayed with a mixture consisting of six pounds of copper sulphate, twenty pounds lime, six pounds of arsenate of lead, one-fourth pound white arsenic (boiled with sal soda), and one hundred gallons of water. Soon after spraying much of the foliage turned brown and dried up. It was plain that spraying was largely responsible for the injury. Close examination revealed the interesting fact that the leaves most affected with scab were the ones most injured by the spray. In fact, the severity of the spray injury seemed to be directly proportional to the amount of scab on the leaves. However, there was some spray injury on leaves apparently free from scab. The explanation of the greater susceptibility of scab-infested leaves to spray injury seems to be as follows: The scab fungus ruptures the cuticle (the protective covering of the leaf) thereby permitting the soluble copper and arsenic compounds in the spray mixture to be readily absorbed by the cells of the leaf.

A similar conclusion was reached by Mr. E. Wallace, who examined the orchard about the time of our own observations.[28]

Observations made at Webster in the season of 1910 lead us to believe that scab-infested apple leaves are particularly susceptible, likewise, to injury from lime-sulphur spray. It seems probable that some of the mysterious cases of lime-sulphur injury to foliage may be explained in this way.

[28] Reported by Whetzel (163, p. 20).

It appears that many fruit growers who are thoroughly acquainted with scab as it occurs on apple fruit do not know it on the leaves.

Rust, *Gymnosporangium macropus* Lk.[29] Although the red cedar, *Juniperus virginiana*, which is the host of the telial stage of this fungus, is quite common in many localities in the State, the æcial stage (*Ræstelia pyrata*) is rarely injurious to apples here. It is only on Long Island and a few places in the Hudson valley that the fungus has any economic importance. To apple growers in western New York, rust is practically unknown. We saw a little at Dresden in 1900[30] and at Geneva in 1908 and 1910. Even in the Hudson valley where red cedars are very plentiful the apple rust is but little known to fruit growers. In 1899 we found "cedar apples" quite commonly in Ulster and Rockland counties, but no Ræstelia that year.[31] The only case of apple Ræstelia coming to our notice in 1901 occurred at Highland. In 1902, specimens were received from several localities in the Hudson valley. In 1906, specimens were received from Hudson, together with the report that it occurred in several orchards there. In 1907, a report of an orchard badly infested came from Crown Point on Lake Champlain.[32] In 1909, and again in 1910, a young orchard of the varieties Wealthy and Jonathan, at Milton, was slightly affected.[33] In this case the infection must have come from a considerable distance. There were no red cedars in the immediate vicinity of the orchard. In 1910, specimens were received from correspondents at Hoosick Falls and Mount Kisco, both of whom stated that the disease was new to them. On Long Island, the fungus was infrequent in 1895.[34] Specimens of Ræstelia on leaves of wild apple were collected at Jamesport in 1896[35], and at Cutchogue in 1900.

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[29] Some of the apple Ræsteliæ mentioned here may be the æcia of *Gymnosporangium globosum* Farl. since this species occurs in the State (See p. 376 and Pammel 87, p. 11); but *G. macropus* is much the more abundant.

[30] Stewart et al (152, p. 302).

[31] Stewart and Blodgett (147, p. 285).

[32] Host Herbarium Specimen No. 3.

[33] Host Herbarium Specimen No. 4.

[34] Stewart and Carver (148, p. 544).

[35] Host Herbarium Specimen No. 5.

Since 1902, we have had under observation an apple orchard on the farm of F. A. Sirrine, near Riverhead, Long Island. This orchard is surrounded on three sides by thickets of red cedar. In 1902, the swelling of the "cedar apples" on the adjacent red cedars occurred on May 28th. Some trees were literally loaded down with them. But, unfortunately, we have no record of the prevalence of rust on the apple leaves that season. The spring of 1903 was very dry. At Riverhead there was no precipitation of any importance between April 16th and June 8th. As a consequence, there was no opportunity for the infection of apple leaves until June 8th and 9th, on which dates there were heavy showers, and the "cedar apples" became swollen into yellowish, gelatinous masses of unusually large size. Very little rust occurred on the apple leaves that year. On June 1, 1904, Roestelia spots were already appearing on the apple leaves in this orchard. The rust-resistance of the Baldwin is shown by the fact that in August, 1904, a Baldwin tree in this orchard was entirely free from Roestelia, while adjacent Russet trees on the north and west were yellow with it. In 1905, there was very little rust here. In December, 1907, Mr. Sirrine brought us a Ben Davis apple from his orchard showing Roestelia in the calyx cavity. In the autumn of 1909, examples of Roestelia on apple fruit were plentiful, particularly on the varieties Ben Davis and Rome.[36] (Also, we saw it on fruit of wild apples at Cutchogue.) In 1910, there was only a little rust on the leaves and on an occasional fruit of Ben Davis.

Another orchard, set by Mr. Sirrine in 1905, furnished (in 1909) some data on the relative susceptibility of different varieties. Although these young trees were sprayed twice with bordeaux — June 1st and about two weeks later — some varieties showed much rust.[37] Wealthy, Boiken and Rome were very rusty;

[36] Museum Specimen No. 133.

[37] On June 3, 1909, the writer observed that the "cedar applies" of *G. macropus* in the vicinity of this orchard were fully expanded by the rains occurring at that time. Whether there had been an earlier opportunity for infection we do not know.

Hubbardston and Sutton were slightly affected; while McIntosh, Yellow Transparent, Gravenstein, Red Astrachan and Oldenburg were nearly or quite free from rust. It may be added that Mr. Sirrine has usually had little success in controlling rust in his bearing orchard by the method of spraying described on page 313. However, he states that, in 1910, trees given two applications of bordeaux (3–3–50 formula) showed only one-tenth as much rust as the unsprayed portion of the orchard. The first application was made on April 30th, as the blossoms were commencing to open, the second on May 21st. Very small, yellow rust spots were plentiful on the leaves of unsprayed trees on June 15th.

Variegated foliage. In 1896, we observed, at Jamesport, Long Island, a bearing apple tree on which practically all of the leaves were beautifully variegated with yellow. The following year, also, all of the foliage on this tree was again variegated. But an adjacent tree which showed variegation on one of its branches in 1896 was entirely free from variegation in 1897. A third tree had variegation on two branches in 1897.[38] In 1907, specimens of variegated apple leaves were brought to us by a Wayne county fruit grower who said that only a few branches in the tree were affected.[39] On an apple tree in the orchard of H. L. Bulkley, Brockport, N. Y., certain branches show variegated leaves year after year. In 1910, a row of two-year-old apple trees in a nursery at Geneva had more or less variegated foliage on almost every tree. The variety was Boskoop and the length of the row about thirty rods. In most cases only a few leaves in the lower part of the tree were variegated.

Powdery mildew, *Podosphæra leucotricha* (E. & E.) Salm.[40] Peck[41] has reported this fungus from Clyde, N. Y., and several outbreaks of it have come to our attention. In one case it occurred in one of the Station greenhouses on some young Bald-

[38] Host Herbarium Specimen No. 6.
[39] Host Herbarium Specimen No. 7.
[40] Salmon (116, p. 40).
[41] Peck (100, p. 19)

win apple trees used by the Station Horticulturist in his investigations on bordeaux injury. It first appeared about March 1, 1907, and by March 26th every tree in the greenhouse was more or less affected, some of them being quite severely injured. The mildew shows first on the upper surface of the leaf and its coming is heralded by the appearance of spots of lighter green color. As the mildew spreads the affected leaves appear as if dusted with flour. The petioles, young stems and under surface of the leaves also became affected, but the most luxuriant growth was invariably on the upper surface. By March 26th there were mature perithecia seated on patches of brown, felted mycelium on the young stems and petioles.[42] No perithecia were observed on the leaf blades. Specimens showing perithecia in abundance were taken on May 1st.

In another case the mildew was found in October, 1909, at Geneva, on sprouts growing around the stumps of some apple trees which had been cut down the previous spring. The leaves were white with mildew on the upper surface and there was also a little on the under surface. Perithecia were numerous, but they seemed to be confined almost entirely to the patches of brown mycelium on the stems near the tips of the shoots.[43]

During the season of 1910 powdery mildew was common on young apple trees in New York nurseries. It also occurred frequently in young orchards and occasionally in bearing orchards. Mr. Parrott, the Station Entomologist, reports having seen bearing orchards at Carlton Station and Brockport affected by powdery mildew in May. At Brockport, the ends of branches on trees thirty-six years old were attacked. The writer has seen specimens taken from this orchard and found perithecia of *P. leucotricha* on them.[44]

In a Geneva nursery, perithecia of *P. leucotricha* began to appear as early as June 30th. Many varieties were more or less affected. The varieties Chenango and Black Ben Davis appeared

[42] Host Herbarium Specimen No. 8.
[43] Host Herbarium Specimen No. 9.
[44] Host Herbarium Specimen No. 10.

particularly susceptible. In September, the leaves at the tips of the shoots were dwarfed and whitened with mildew. Often they were curled and brown on the margins. Many of the affected leaves had fallen prematurely. The twigs, also, were covered with mildew, some of which was white and some brown. Large numbers of perithecia were imbedded in the felt-like patches of brown hyphæ on the twigs and petioles and occasionally on the leaf-midribs, but none were seen on the thin parts of the leaves. The growth of the trees had been checked somewhat. Some were considerably injured.

We are under obligations to Mr. V. B. Stewart, of the New York College of Agriculture, for a quantity of fine specimens of *P. leucotricha* collected in a nursery near Orleans, N. Y., where he found it very abundant in the summer and autumn of 1910.

In reporting the results of some experiments on the treatment of the diseases of nursery stock in western New York in 1891 and 1892, Fairchild mentioned an apple powdery mildew which he doubtfully referred to *Podosphæra oxyacanthæ* (DC.) Winter.[45] However, there are good reasons for believing that it was, in reality, *P. leucotricha*. In the Station herbarium there is a specimen[46] of powdery mildew on apple labeled *Podosphæra oxyacanthæ* (DC.) DeBy. The envelope containing it bears the following note in the handwriting of Prof. S. A. Beach: "On stems and leaves of *Pirus malus* L. nursery seedlings. In some seasons it does much damage to nurseries in vicinity of Geneva as well as elsewhere throughout the Northern States. Col. by D. G. Fairchild and S. A. Beach Oct. 21, 1892 near State Exper. Station, Geneva, N. Y. Showing perithecia." Probably this specimen represents the powdery mildew mentioned by Fairchild. Upon examination it is found to be *Podosphæra leucotricha* (E. & E.) Salm. The perithecia occur only in brown patches of mycelium on the stems and petioles and have the two kinds of unbranched appendages characteristic of *P. leucotricha*.[47]

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[45] Fairchild (35, p. 256); also, N. Y. (State) Sta. Rpt. **11**:663. 1893.
[46] Host Herbarium Specimen No. 11.
[47] Salmon (116, Pl. 7, figs. 119, 120).

The occurrence of *Podosphæra oxyacanthæ* on nursery apple trees in New York has also been reported by the writer.[48] In this case, likewise, there is some doubt as to the identity of the fungus. No specimens were preserved, but in the original notes (still in our possession) it is distinctly stated that no perithecia were observed. Such being the case it was impossible to determine the species accurately. It seems that the determination was based on the fact that the fungus grew more abundantly on the under than on the upper surface of the leaves. It also occurred on the stems. The observations were made August 8, 1910.

Of course it is possible that *P. oxyacanthæ* sometimes occurs on the apple in New York, but no authentic instance is known to us. All of the specimens (showing perithecia) which have come to our attention belong to *P. leucotricha*.

Fungus Parasite of San José Scale, *Sphærostilbe coccophila* Tul. This is a fungus which lives parasitically on various species of scale insects. It is quite widely distributed throughout the warmer regions of the world. In 1897, Rolfs[49] called attention to its occurrence on the San José scale in Florida where it seemed to be an important factor in keeping the insect in check. He showed how the fungus may be cultivated artificially and used to combat the scale. In 1908, Fawcett[50] stated that there had been found an effective method of distributing the fungus which has saved thousands of dollars to the peach and orange growers of Florida. Although the fungus is reported as occurring naturally as far north as Elberon, N. J.,[51] attempts to introduce it into the Northern States and Canada have been unsuccessful.[52] Even in Alabama and Georgia where the fungus grows abundantly on the oak scale, *Chrysomphalus obscurus*, it is inefficient for the control of San José scale.[53] It appears that Florida is the only

[48] Stewart et al (152, p. 302).
[49] Rolfs (111, 112 and 113).
[50] Fawcett (38, p. 28).
[51] Smith (130, p. 567).
[52] Smith (128, pp. 470–479); 129, p. 445; 130, p. 567; Forbes (39, pp. 270–280); Webster (161, p. 198); Craig (23, p. 119).
[53] Earle (30, p. 175); Lewis (71).

State in the Union in which the fungus is of recognized value in the control of the scale.

Such being the case, it is an interesting fact that in October, 1909, we found this fungus very abundant in a scale-infested apple orchard near Hicksville, Long Island. The orchard has been infested with San José scale about ten years, during which time it has been neither pruned nor sprayed. Although all of the trees are covered with the scale only a few have died. The majority are still in fair condition. Given proper care, the orchard could be made to produce fair crops of apples still, notwithstanding the fact that the scale has had its own way with the trees for ten years. What part the fungus has had in holding the scale in check in this orchard can only be conjectured, since nothing is known of its occurrence there prior to 1909. It can only be said that in October, 1909, the fungus was epidemic, growing on the bodies of the scale insects wherever there were any to be found in every living tree in the orchard. The fungus was readily discernible to the unaided eye as minute pink cushions, knobs or conical projections scattered over the scale-infested bark. Whether it occurs in other scale-infested orchards on Long Island we do not know. No search for it has been made. Perhaps, on Long Island, the fungus may be of some assistance in checking the ravages of the scale in neglected orchards. In other parts of New York it is probable that climatic conditions are unsuited to it.[54] However, we have seen traces of the fungus on scale-infested currant canes in the Hudson valley and also at Geneva.

It should be understood that probably the fungus cannot be used, successfully, in orchards sprayed with lime-sulphur since it is likely that lime-sulphur will kill the fungus. For this reason it can be of little use to commercial orchardists in this State. In scale-infested orchards spraying with lime-sulphur cannot be omitted.

[54] A moist climate is considered favorable to the development of the fungus, but the summer of 1909 was a very dry one on Long Island.

A brief account of the above observations published[55] in November, 1909, is the earliest record of the occurrence of the scale fungus in New York. No perithecia were found — only the conidial form known as *Microcera coccophila* Desm.

Trunk injury. In May, 1910, some observations were made on an interesting disease of apple tree trunks at Le Roy. The orchard in which the trouble occurred contained 450 moderately thrifty trees, nine and ten years old, growing in timothy sod. All of the trees had been topworked; 300 of them had Walbridge stocks, while the remainder had Northern Spy stocks. In the fall of 1906, veneer tree protectors, twenty inches high, were placed around the trunks of all the trees to protect them from mice. These "protectors" consisted of thin sheets of wood which were wrapped loosely about the bases of the tree trunks and held in place by wire bands. They were left on the trees continuously until the spring of 1910. It was then discovered that about sixty of the trees on Walbridge stocks were more or less injured. On the portion of the trunk covered by the "protector" the bark was rough and showed numerous dead spots of various sizes from mere specks to spots as large as a man's hand. The smaller spots did not extend through the bark, but on many of the larger ones the bark was dead all the way through and the sap-wood was bluish black. Occasionally, the diseased spots occurred well up on the trunk, even to the crotch, but the great majority of them were within twenty inches of the ground. Several of the trees were practically ruined, and a number of others were considerably injured. The owner first noticed a few of the trees affected in the spring of 1908, and a few more in 1909; but the greater part of the trouble first appeared in the spring of 1910.

It was plain to be seen that the veneer tree protectors were, in some way, responsible, but the exact manner in which the trouble had been brought about was not clear. The canker fungus, *Sphæropsis malorum*, may have been a factor since some of the larger spots showed pycnidia of this fungus. The bark under the "protectors" was thickly covered with the oyster-shell

[55] Stewart (146).

scale, *Lepidosaphes ulmi* Linn., which may, also, have been a factor. The owner states that in April and again in the forepart of July there was a copious exudation of sap from the diseased spots. This might lead to the suspicion that the fire-blight organism, *Bacillus amylovorus,* had something to do with it, but the writer is confident that such was not the case. There was no other evidence of fire blight in the orchard.

The trouble was confined to the trees having Wallbridge stocks. Those with Northern Spy stocks were entirely free from it. Since all the conditions surrounding the two kinds of stocks were alike, it seems fair to conclude that Wallbridge is the more susceptible to such injury. As remedial measures, the orchard was plowed and the tree trunks painted with a mixture of lime, copper sulphate and linseed oil after they had first been well scraped with wire cloth and all dead bark removed from the larger cankers.

In September the owner reported that several apparently new cases had appeared during the summer. He thinks that the mixture of lime, copper sulphate and linseed oil had little influence on the disease, but that cutting out the spots of diseased bark checked it somewhat.

ASPARAGUS.

Asparagus officinalis.

Rust, *Puccinia asparagi* DC. In New York, asparagus rust has been destructive nearly every season since its first appearance on Long Island in 1896.[56] On Long Island, especially, the loss has been heavy. Sirrine's experiments,[57] published in 1900, showed plainly that rust may be largely prevented and the yield and quality of asparagus much increased by spraying with resin bordeaux mixture. Since 1903, Mr. Sirrine has grown asparagus on his own farm at Riverhead and practiced regular spraying. He is thoroughly convinced that spraying is profitable. While

[56] Stewart (139, p. 458).
[57] Sirrine (127).

unable to control rust, entirely, he has succeeded in preventing it from causing serious damage. Also, he has reached the conclusion that the addition of resin to the bordeaux does not increase its efficiency enough to warrant using it. The resin seriously interferes with the operation of the spray pump. He now uses ordinary bordeaux mixture.

Mr. Sirrine informs us that Long Island asparagus growers do not spray or employ any other special treatment for rust. They now plant chiefly the varieties which have been found most rust-resistant, namely, Palmetto and Argenteuil; but these varieties are not nearly so resistant as they were formerly supposed to be.

Sirrine states[58] that, on Long Island, the æcial stage of *Puccinia asparagi* appears about June 1st. June 4, 1901, we found æcia abundant in a two-year-old asparagus bed at Poughkeepsie. They occurred only on the lower ten or twelve inches of the stalk.[59] June 2, 1909, we found uredo sori on volunteer asparagus plants at Riverhead. Mr. Sirrine is positive that he saw some uredo sori as early as May 15th — the earliest he ever saw them. In this case the æcia must have appeared about May 1st. In 1910, æcia were observed at Riverhead by Mr. Sirrine on May 5th.

Halsted[60] has recorded an observation which led him to express the opinion that the time required for the rust to appear in pustules upon the asparagus is about three weeks. In 1898, the writer made a similar observation indicating that the period of incubation is under, rather than over, three weeks. On August 14th a rusted asparagus bed at Mattituck was mown off close to the ground. Twenty-four days later (September 7th) we found many plants of the new growth showing uredo sori; and Mr. F. H. Blodgett, who examined the plants one day earlier, informed us that he, also, observed some uredo sori. Taking into consideration the fact that the plants required some time to start new shoots, and that the sori probably appeared some time before the

[58] Loc. cit. p. 236.
[59] This habit has been observed also by Clinton (21, p. 314).
[60] Halsted (48, p. 347).

observations were made, it appears that the actual period of incubation must have been less than three weeks. It is probable that the infection came from uredospores.

BEAN.

Phaseolus vulgaris.

Powdery mildew, *Erysiphe polygoni* DC.? In October, 1909, some string beans (*Phaseolus vulgaris*) in a garden at Cutchogue, Long Island, were found affected with powdery mildew. At the time the observations were made most of the bean leaves were already dead, from frost, but it was evident that the mildew had been abundant. The leaves (both surfaces) and leaf petioles were thickly covered with the conidial form of a powdery mildew.[61] As no perithecia were found the identity of the fungus must remain in doubt. It appears that beans are not often attacked by powdery mildew. This is the first time the writer has seen it, and so far as we can learn, it has not been recorded previously as occurring in New York. Galloway[62] has reported powdery mildew on beans at St. George, Bermuda. In this case the fungus was doubtfully referred to *Erysiphe communis* Lév. (= *E. polygoni* DC.)[63] Prillieux[64] gives the "haricot" (*Phaseolus vulgaris*) as one of the hosts of *Erysiphe communis.*

Increased number of cotyledons. Recently, we saw ten common white beans having three cotyledons (seed leaves) each, and another having four cotyledons. There can be no doubt about the accuracy of the observation in either case.

BEECH.

Fagus grandifolia.

White heart-rot, *Fomes igniarius* (L.) Gillet. During August, 1909, the writer, in company with Dr. B. M. Duggar

[61] Host Herbarium Specimen No. 12.
[62] Galloway (45).
[63] Salmon (116, p. 182).
[64] Prillieux (105, 2:16).

and Prof. H. H. Whetzel, made some observations on the heart-rot of beech trees in the vicinity of Seventh Lake in the Adirondack Mountains, where the beech is one of the principal hard-wood timber trees. This disease has been so fully treated by Atkinson[65] and von Schrenk and Spaulding[66] that little need be added. Peck[67] and Murrill,[68] also, have reported its occurrence in New York. However, it may be worth noting that this heart-rot is very common and destructive to the beech trees around Seventh Lake; also, that the conditions found there are quite in accord with von Schrenk and Spaulding's statement that, "In New York and New England the beech has been found to be the most common host of this fungus." While the fungus was most commonly found on beech[69] it was observed, also, frequently on striped maple (*Acer pennsylvanicum*),[70] occasionally on sugar maple (*A. saccharum*)[71] and yellow birch (*Betula lutea*) and once on aspen (*Populus tremuloides*).[72] One of the largest sporophores (on beech) was 3 dm. (12 inches) wide, 2 dm. (8 inches) thick at the base and, judging by the number of layers of pores, about 15 years of age.[73] A considerably larger sporophore, probably 4.5 dm. (18 inches) wide, was seen but not measured. The sporophores are usually found on standing trees (commonly on living ones) and are few in number — usually one to four.

Tinder-fungus rot, *Fomes fomentarius* (L.) Gill. With one exception (*Fomes applanatus*), *Fomes fomentarius* is probably the most common representative of the Polyporaceæ growing on deciduous trees in the vicinity of Seventh Lake. It occurs on prostrate or standing dead trunks of beech, yellow birch and hard maple and occasionally, also, on living trees of the same species. On individual trunks the number of sporophores is often quite

[65] Atkinson (10, pp. 214–222).
[66] von Schrenk and Spaulding (122, pp. 25–37).
[67] Peck (88, p. 83; 91, p. 36; 98, p. 218).
[68] Murrill (82, p. 111).
[69] Museum Specimen No. 80.
[70] Museum Specimen No. 11.
[71] Museum Specimen No. 36.
[72] Museum Specimen No. 54.
[73] Museum Specimen No. 5.

large — twenty to forty or more. Like many other fungi of this family the sporophores of *Fomes fomentarius* have a decided tendency to grow toward the earth (positive geotropism). Invariably, they grow with the hymenium turned toward the earth. This habit was interestingly shown by a colony of sporophores on a fallen beech tree near Limekiln Lake observed by the writer in August, 1909. (Plate II.) The tree, which was about two feet in diameter, had been blown over some time during 1908, probably; yet it was in full leaf and, apparently, very much alive. On one side of the lower portion of the trunk there were more than forty sporophores of *Fomes fomentarius* scattered over an area about ten feet long by two feet wide. The majority of the sporophores had been formed before the tree fell, and, in these, the hymenium faced the base of the tree; while in others, formed after the tree fell, the hymenium faced the earth. There were, also, a few sporophores which were twisted in consequence of having changed their direction of growth at the time the tree fell.[74] (Plate III, fig. 2.)[75]

Recently, von Schrenk and Spaulding[76] have questioned the parasitism of *Fomes fomentarius*. In the instance cited above it seems to us that the evidence is in favor of its being parasitic. On the diseased portion of the trunk the dead bark adhered closely and there were no wounds or exposed wood. Neither was there evidence of the presence of any other fungus which might have killed the bark.

Several good examples of twisted sporophores were collected near Seventh Lake in 1910. Some were on beech and others on hard maple. One of these, on beech, is shown in Plate III, fig. 1. In this case the tree fell in such manner that the sporophore was on the upper side of the prostrate trunk. With the renewal of growth there appeared on the old sporophore three new sporo-

[74] Similar cases in *Fomes applanatus* and *Dædalea ambigua* have been described and illustrated by Atkinson (9, pp. 15–17).

[75] Museum Specimen No. 15.

[76] von Schrenk and Spaulding (122, p. 49).

phores (two of them partially grown together) with hymenial surfaces in a plane at right angles to that of the parent sporophore.[77]

The largest sporophore we have found was on a standing dead trunk of hard maple. It was 1.5 dm. (six inches) wide on the attached side and 3.4 dm. (13.5 inches) in circumference.[78]

Fomes pinicola Fr. The usual hosts of *F. pinicola* are coniferous trees, but it occurs occasionally also on beech and other deciduous trees.[79] At Seventh Lake we have observed it on dead trunks of beech[80] and sugar maple.[81] All of the sporophores lacked the reddish marginal zone usually found in specimens on coniferous trees. This has been noted previously by Peck.[82]

BEET.

Beta vulgaris.

Cercospora leaf-spot, *Cercospora beticola* Sacc. In New York, this is usually a very common and, often, destructive disease of sugar beets,[83] but it was rare in 1909. On October 6, 1909, several large fields of sugar beets in the vicinity of Geneva were carefully examined and Cercospora found to be so rare that a long search was necessary to find a single spot caused by it.

During several years past this Station has coöperated with the United States Department of Agriculture in some investigations on the improvement of the sugar beet. In the experiment conducted on the Station farm in 1902, there was an instructive outbreak of *Cercospora beticola*. The experiment field contained twelve long, narrow plats (11.7 x 167 feet) each having an area of one-eighth acre. The various plats were planted with seed grown in different parts of the United States, France and Germany, as follows:

Plat 1. Klein-Wanzleben. Grown in Germany.
Plat 2. Klein-Wanzleben. Grown in Germany.

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77 Museum Specimen No. 115.
78 Museum Specimen No. 6.
79 Atkinson (10, p. 227); von Schrenk (120, p. 24); Peck (99, p. 169); Murrill (83, p. 228); Romell (114).
80 Museum Specimen No. 19.
81 Museum Specimen No. 43.
82 Peck (99, p. 169).
83 Duggar (27, p. 352).

Plat 3. Dippe Elite Klein-Wanzleben. From Germany.
Plat 4. Vilmorin. French. Very rich in sugar.
Plat 5. Klein-Wanzleben. Utah grown.
Plat 6. Klein-Wanzleben. California grown.
Plat 7. Strand's Klein-Wanzleben. From Germany.
Plat 8. Hoening Improved Klein-Wanzleben. Germany.
Plat 9. Jaensch's Victrix.
Plat 10. Klein-Wanzleben. Michigan grown.
Plat 11. Klein-Wanzleben. Grown in Washington State.
Plat 12. Klein-Wanzleben. Washington grown.

Early in August, 1902, *Cercospora beticola* began to appear on Plat 10. By August 21 this plat was badly diseased throughout its entire length while only traces of the disease were to be found on any of the other plats excepting the two adjacent ones (Nos. 9 and 11) on which there was a light sprinkling of spots. A month later the disease had spread over the entire field, but not much damage had been done except on Plat 10, which was now conspicuous because of a second growth of dark green leaves, practically all of the early leaves having been destroyed by the Cercospora.

The circumstances attending this outbreak indicate plainly that the disease was transmitted with the seed used on Plat 10. The probability of *Cercospora beticola* being transmitted with the seed was shown some years ago by Frank who pointed out that the fungus attacks the seed-balls as well as other parts of seed-bearing plants.[84]

Phyllosticta leaf-spot, *Phyllosticta betæ* Oud.[85] Phyllosticta disease of beets in this State has come to our attention but once, viz., at Flint, in August, 1900. In a field of sugar beets there were a few small areas on which the lower leaves of the plants showed circular, dead brown spots 5 to 10 mm. in diameter.[86] The upper surface of the spots was dotted with black pycnidia visible to the unaided eye. The spores were hyaline,

[84] Frank (41).
[85] Identified by C. H. Peck.
[86] Host Herbarium Specimen No. 13.

non-septate, 3-4 x 4-6 μ. It was not observed that the disease affected the roots.

This is probably the same as the Phyllosticta leaf-spot and root-rot of beets described by Halsted in New Jersey.[87]

BEGONIA.

Begonia sp.

Powdery mildew. February 3, 1900, the writer observed a powdery mildew on begonias in a greenhouse at Queens, N. Y. It was common on the stems but did not attack the leaves. As no perithecia were found, the species could not be determined. We have found no published record of the occurrence of powdery mildew on begonia.

Eelworms in the leaves. In December, 1899, we received from Queens, N. Y., specimens of begonia leaves showing large, irregular, dead, brown areas. Microscopic examination of the diseased tissue revealed the presence of numerous eelworms which were probably the cause of the disease. The species of the eelworm was not determined. Halsted[88] has reported a nematode disease of begonia leaves in New Jersey. In England, a similar leaf disease of begonias is caused by *Aphelenchus olesistus* Ritzema-Bos.[89]

BLACKBERRY.

Rubus spp.

Orange rust, *Gymnoconia peckiana* (Howe) Dug. In the æcial stage, known as *Cæoma nitens* Schw., this fungus is a well known destructive parasite of blackberries and black raspberries in New York; but the telial stage is practically unknown except to mycologists. Although not rare, it is much less common than the æcial stage and also quite inconspicuous. In August, 1909, Dr. Duggar and the writer found the telial stage exceedingly abundant on the foliage of wild blackberries in the vicinity of Seventh Lake and Limekiln Lake in the Adirondack Mountains. Viewed from the

[87] Halsted (53, pp. 338–340).
[88] Halsted (49, p. 310).
[89] Anonymous (2); Ritzema-Bos (108).

upper surface the affected leaves appeared normal except for their yellowish color. On the under surface they were thickly dotted with small black sori. Apparently, the growth of the plants was but slightly affected.[90]

Fasciation. A fasciated cane of cultivated blackberry[91] was found at Charlotte, N. Y., June 2, 1903. It was affected with orange rust and was entirely free from prickles, as is frequently the case with rusted canes.[92]

Rust, *Kuehneola albida* (Kühn) Magn. The pale, yellowish-white color of the telial sori distinguishes this from the other rusts infesting blackberries. Apparently, it is not common in New York. In September, 1901, we found the telial stage occurring sparingly on the leaves of cultivated blackberries at Milton and Highland. Dr. D. Reddick informs us that he found it abundant on wild blackberries at Ithaca in September, 1906.

BLUEBERRY, SWAMP
Vaccinium corymbosum.

Rust, *Calyptospora goeppertiana* Kühn. The Station museum contains an exceptionally fine large specimen of the witches' broom deformation caused by this fungus.[93] It was found by F. A. Sirrine in a swamp near Riverhead, Long Island, in 1905. The host plant was probably, *Vaccinium corymbosum*, the swamp blueberry.

Arthur,[94] in giving the distribution of *C. goeppertiana* in America, does not mention New York. Nevertheless, Peck[95] has reported its occurrence at Fulton Chain on *Vaccinium canadense* and at Sandlake on *V. corymbosum*. In 1909, Prof. Whetzel found it at Labrador Lake, near Tully, and in May, 1910, he and Dr. Reddick took another specimen from the same locality.

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[90] Host Herbarium Specimen No. 14.
[91] Host Herbarium Specimen No. 15.
[92] Stewart and Blodgett (147, p. 287).
[93] Museum Specimen No. 97.
[94] Arthur (6).
[95] Peck (96, p. 112). Reported under the name *Cryptospora goeppertiana*, which is evidently a slip of the pen.

Peridermium columnare Schm. & Kze., the æcial form of *C. gæppertiana* has been unknown to America until last year when it was discovered at Pictou, Nova Scotia, on leaves of balsam.[96] The fungus which Peck[97] found on hemlock leaves at Sandlake, N. Y., some 30 years ago and identified as *Peridermium columnare* proved to be a different species and was subsequently described by von Thümen under the name *Peridermium peckii*. It is now known as *Æcidium peckii* (Thm.) Diet.

BOX.

Buxus sempervirens.

Cuttings fail to root.[98] While inspecting a Geneva greenhouse during January, 1910, a small bed of imported box-tree cuttings attracted the writer's attention. Many of the cuttings had failed to root. An examination showed that the stem, and in some cases also the leaves, of all that had failed were covered with conspicuous, black, erumpent pycnidia.[99] In all cases the fungus invasion progressed from the basal toward the apical portion of the cutting. Invariably, the portion of the cutting covered by the sand was the part most seriously affected. The diseased cuttings were freely intermixed with healthy ones and no one portion of the bed seemed more seriously affected than another. To what extent the fungus is responsible for the failure of the cuttings is not clear; but its constant occurrence on affected cuttings, even on those still partly green, indicates that it is a factor in the trouble. Neither is it known how the cuttings became infected — whether from the mother plant or from the soil in the cutting bench.

The fungus was determined by Mr. Chas. H. Peck to be *Phoma stictica* B. & Br. It is interesting to note that this form was regarded by Nitschke[100] as the spermagonial stage of *Diaporthe*

[96] Fraser (42).
[97] Peck (89, p. 61).
[98] By S. M. McMurran.
[99] Host Herbarium Specimen No. 16.
[100] Nitschke (84, p. 305).

retecta Fckl. & Nits. and identical with the *Cytospora buxi* of Desmazieres. Allescher[1] regards *Ph. stictica* as synonymous with *D. retecta*, but gives *Cytospora buxi* Desm. as an independent species.

BRUSSELS SPROUTS.

Brassica oleracea.

Club-root, *Plasmodiophora brassicæ* Wor. In 1901 a field of brussels sprouts at Mattituck, containing 2.5 acres, was completely ruined by club-root. Over the entire field the plants all collapsed at practically the same time, about September 5. Traces of the disease were found in several other fields, but after a rather thorough examination of many fields in the vicinity of Cutchogue, Mattituck and Riverhead the conclusion was reached that club-root was not very troublesome there in 1901.

CARNATION.

Dianthus caryophyllus.

Cohesion of petals. In March, 1907, a florist at Ulster Park, N. Y., sent to the Station some carnation blooms (variety, Wm. Scott) which were not opening properly because of the cohesion of the petals. The sender stated that the varieties Eldorado and Fisher were similarly affected. The petals were well out of the calyx, but stuck together. Upon examination it was found that, in some cases, the petals were actually grown together to such an extent that it was impossible to separate them without tearing the tissues. This is the only instance of the kind coming under our personal observation. However, the same trouble was described in 1896 by Arthur[2] whose studies were made on material from Jamestown, N. Y. It has also been mentioned, occasionally, in the floricultural journals.[3] The cause is not known.

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1 Allescher (3, pp. 183 and 571).
2 Arthur (5).
3 *Am. Gardening* **17** (1896):145; *Florists' Ex.* **8** (1896):167, 197, 214, 242; **17** (1904):401.

CEDAR.

Juniperus virginiana.

Rust, *Gymnosporangium nidus-avis* Thax. The object of the following note is to call attention to the fact that *Gymnosporangium nidus-avis* brings about *reversion to the juvenile form* in the branches attacked by it. In their youth many plants have a form or habit more or less different from that of the mature plant. In such cases the form assumed by the plant when young is known as its juvenile form. In the juvenile form of the red cedar, *Juniperus virginiana*, the leaves are linear-lanceolate, spiny-pointed, spreading, 1 cm. (nearly one-half inch) long; while on older trees they are scale-like, rhombic, imbricated, 1.5 mm. (one-sixteenth inch) long. Frequently, both sorts of leaves may be found on the same plant.

Gymnosporangium nidus-avis is an heteræcious rust first described by Thaxter in 1891.[4] Its æcia occur on the leaves of quince and the leaves, stems and fruit of *Amelanchier canadensis;* while in the telial stage it attacks the trunks and branches of red cedar, producing the so-called "bird's nest" distortions which consist of dense clusters of short branches.

On the north shore of Long Island, where *G. nidus-avis* is exceedingly common in the red cedar thickets, the leaves on the affected branches in the "bird's nests" are quite generally like those of the juvenile form; that is, the attack of the fungus causes reversion to the juvenile form.[5] This is not a new observation. An account of it was published by Jackson[6] eleven years ago. It has also been mentioned by Freeman.[7] But it appears to be still unknown to many botanists. In 1905, Klebahn,[8] writing of an instance in which reversion to the juvenile form resulted

[4] Thaxter (155).
[5] Museum Specimen No. 89.
[6] Jackson (66, p. 118).
[7] Freeman (43, p. 55); Pammel (87, p. 29); and others have noted that the leaves on affected branches are larger than normal and spiny, but seem not to have recognized it as a case of reversion to the juvenile form.
[8] Klebahn (69, p. 90).

from the artificial infection of *Pinus strobus* with *Cronartium ribicola,* made a statement which we translate from the German as follows: "The case of plant parasites as the cause of reversion appears to me not to be supported by especially numerous definite observations. I find only an account by Schäffer, according to which needles instead of scale-like leaves appear on *Juniperus sabina* in consequence of fungus attack, and, moreover, this account is not very exact since the fungus which was presumably *Gymnosporangium sabinæ* (or *confusum*) was designated as *Peronospora juniperina.*" Klebahn seems to have overlooked Jackson's paper above mentioned.

This case of *Gymnosporangium nidus-avis* is certainly a striking example of reversion to the juvenile form caused by the attack of a parasitic fungus. It is also instructive, since the manner in which the reversion is brought about seems to be clear.

The causes inducing reversion to the juvenile form are said to be various. Beyerinck[9] says that "all circumstances which prejudice nutrition favor the retention of the juvenile character;" also, that reversion to the juvenile form may result from injuries by frost, insects, plant parasites and wounding of the roots; but he cites no example of a plant parasite causing it. Goebel[10] states that his experiments have shown that in a number of instances reversion to the juvenile form takes place chiefly when the conditions of vegetation are unfavorably influenced, as for example, when certain water plants were wintered as land plants. Goebel says further:[11] "We may say generally that the reversion shoots appear at definite places and usually near the base of the plant." This, he says, is the case in certain genera of the Cupressineæ. Schäffer[12] says: "It is by no means always defective nutrition which leads to the production of reversion forms;" also, that there have been made abundant observations showing that old stems and branches produce the juvenile form mostly as the result of more vigorous nutrition.

[9] Beyerinck (14).
[10] Goebel (46, p. 171).
[11] Loc. cit. p. 173.
[12] Schäffer (119).

Our case of reversion in the red cedar is plainly of the kind described by Schäffer. Instead of occurring near the base of the tree the "bird's nests" are found in any part of the tree top. The writer has seen large specimens occupying the extreme top of the tree.[13] The reversion here is clearly the result of increased metabolism. The effect of the fungus is to stimulate rapid growth in the affected branches and it is on the most rapidly growing shoots that the reversion is most pronounced. In some of the "bird's nests" the fungus, for some reason, dies out. In such cases there is little or no evidence of reversion. There are, also, intermediate forms in which the fungus is more or less active and the greater the activity of the fungus the more pronounced the reversion.

That the juvenile form in the red cedar is favored by good nutrition is shown by the fact that it persists longest in vigorous shoots. Sargent,[14] speaking of the kind of leaves characteristic of the juvenile form, says that they occur "on young plants and vigorous branches."

From an examination of the literature of the subject it appears that there are recorded only three examples[15] of reversion to the juvenile form caused by parasitic fungi, viz.:

(1) *Peronospora juniperina* (probably *Gymnosporangium* sp.) on *Juniperus sabina,* recorded by Schäffer;[16]

(2) *Cronartium ribicola* on *Pinus strobus,* recorded by Klebahn;[17]

(3) *Gymnosporangium nidus-avis* on *Juniperus virginiana,* recorded by Jackson;[18]

Perhaps a critical study of the numerous witches' brooms caused by fungi would enlarge this list.

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[13] Museum Specimen No. 134.

[14] Sargent (118).

[15] Halsted (50) has described and illustrated reversion in the red cedar caused by *Gymnosporangium claripes* C. & P. This may be a fourth example, but it is not improbable that the fungus was incorrectly determined and that it was, in reality, *G. nidus-avis.*

[16] Schäffer (119).

[17] Klebahn (69, pp. 86–91).

[18] Jackson (66, p. 118).

CHERRY.

Prunus spp.

Brown rot, *Sclerotinia fructigena* (Pers.) Schroet. On May 24th, 1909, at the time cherries were just going out of bloom, a Geneva fruit grower brought to the Station some branches of sour cherry showing a large percentage of the blossoms brown and blighted. He reported the damage considerable and stated that in 1908 the same trouble had practically ruined his crop. Casual examination failed to detect the presence of any fungus, but when the blighted blossoms were placed in moist chamber 80 per ct. of them developed a copious growth of Monilia in 40 hours. It is likely that the blossoms were killed by Monilia. Arthur[19] reports that Monilia killed cherry blossoms at Geneva in 1885. In the spring of 1905 two trees of Heiderman sand cherry on the Station grounds lost most of their blossoms from Monilia. This variety appears especially susceptible to Monilia attack. Besides the blossoms, so many branches were killed by the Monilia that fully one-half the foliage on the trees died. The following varieties of plums adjacent were entirely unaffected: Newark, Miles and a seedling of Bavay Green Gage.

At Highland, June 13th, 1901, we observed several English Morello cherry trees on which Monilia had killed large numbers of small twigs two to four inches long. On most of the dead twigs Monilia was fruiting profusely. At the base of each dead twig gum had collected underneath the bark. Frequently, there was an exudation of gum at this point. In July of the same season a similar condition was found to exist in an orchard of English Morello cherries at Geneva. Every tree showed a considerable number of twigs killed by Monilia.

Sometimes, cherry twigs are killed by the fruit bark-beetle, *Scolytus rugulosus*.[20] In such cases, the general appearance of the affected tree is strikingly like that of trees attacked by Monilia twig blight.

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[19] Arthur (4, p. 282).
[20] Lowe (75, p. 122).

In the spring of 1908 a large percentage of the sweet cherries at Milton, N. Y., were destroyed by Monilia while they were still quite young and green — about the size of large peas. Some of the diseased fruits were brown throughout and covered with Monilia, while others were only partly destroyed by a dry brown rot.

Black cherry twig blight, *Sclerotinia scaveri* Rehm. The wild black cherry, *Prunus serotina,* is subject to a twig blight caused by a fungus the conidial stage of which was named by Peck *Oidium destruens.*[21] Some mycologists hold it to be identical with *Monilia linhartiana* Sacc., which causes a similar disease of *Prunus padus* in Europe. The name *Sclerotinia scaveri* is used here because Reade[22] has recently shown this fungus to be the ascogenous form of Peck's *Oidium destruens* (= *Monilia scaveri* Reade).

In gross characters, the black cherry twig blight considerably resembles the Monilia twig blight of sour cherry, the chief difference being that the leaves on affected twigs are usually well covered with the spore masses of the fungus, whereas *Monilia fructigena* rarely fruits on the leaves. Even a hasty microscopic examination might not reveal the difference between the two diseases since *M. scaveri* is very much like *M. fructigena,* except that the spores are only about half as large.

Nearly every season since 1895 the writer has observed wild black cherry trees on Long Island much affected by this disease. It occurs in practically all parts of the State, often quite abundantly, but it is on Long Island that the fungus attains its best development.[23] It is there seen at its best about June 1st. During the first week of June, 1904, there was an epidemic of the disease on Long Island. In some cases 25 to 40 per ct. of the leaves were killed. All through the tops of the trees there were small clusters of dead brown leaves. Upon examination it was found that not only were the leaves affected, but also the shoots

[21] Peck (90, p. 41).
[22] Reade (106).
[23] Host Herbarium Specimen No. 17.

of the current season's growth were dead.[24] The dead shoots were rarely more than 8 cm. (three inches) long and usually bore two to four leaves each. Both shoots and leaves were covered with a gray powder composed chiefly of the spores of the Monilia. On the leaves, the fungus shows a marked tendency to fruit in the vicinity of the large veins, particularly the midrib. It occurs on both surfaces of the leaf, but more abundantly on the upper surface.

This disease is of small economic importance here because the host plant has little value in this State.

Witches' brooms, *Exoascus cerasi* (Fckl.) Sadeb.[25] The writer has previously noted the sparing occurrence of this disease at various places in the State, particularly on Long Island.[26] There is no reason to believe that it will ever become troublesome here. It shows little inclination to spread.

We first became acquainted with this disease in May, 1895, when it was discovered on a single tree of a small-fruited variety of sweet cherry (*Prunus avium*) at Queens, Long Island. Nine years later (May, 1904), this tree was again examined. It was now about 45 cm. (18 inches) in diameter and bore several Exoascus "brooms," but, apparently, it had not suffered from the disease. Moreover, another tree of the same variety standing only five meters (16 feet) distant was entirely free from the disease notwithstanding branches of the two trees interlocked.

Powdery mildew, *Podosphæra oxyacanthæ* (DC.) DeBy. This is a common and sometimes destructive disease of cherries in New York nurseries. In autumn it frequently attacks, also, bearing cherry trees, showing a preference for leaves at the tips of succulent growing shoots.

The mahaleb cherry, *Prunus mahaleb,* appears to be immune to mildew. In October, 1901, the writer observed, near Geneva, a block of sweet cherry nursery trees which were severely attacked

[24] Peck does not mention its occurrence on the shoots.

[25] Host Herbarium Specimens Nos. 18, 19, 20 and Museum Specimen No. 135.

[26] Stewart (137; 138, p. 532; 152, p. 309).

by powdery mildew. The trees had been budded on mahaleb stocks. In a considerable number of cases the buds had failed to "take" and the tops of such stocks had been permitted to grow instead of being cut off just above the point of budding according to the usual custom when the buds grow. Invariably, these mahaleb trees were absolutely free from mildew although closely surrounded by the badly mildewed sweet cherries.

The variety Gov. Wood, a sweet cherry (*Prunus avium*), likewise appears immune to mildew. In a Geneva nursery, two rows of this variety 300 meters (60 rods) long were entirely free from powdery mildew, while the two adjacent rows of the variety English Morello were badly mildewed throughout their whole length. Ten rows of the variety Hoy, near by, were nearly, but not quite, free from mildew. The following other varieties were more or less affected: Baldwin, Bing, Black Tartarian, Dikeman (slightly), Early Richmond (very badly), Lambert (badly), Montmorency (badly), Napoleon Bigarreau, Windsor and Waterloo. These observations were made in October, 1909.

Choke cherry fruit spot, *Cylindrosporium padi* Karst. In July, 1910, the green fruits of some choke cherry trees (*Prunus virginiana*) on the Station grounds were severely attacked by a fungus disease which manifested itself in the form of dead brown spots.[27] Cylindrosporium acervuli well filled with spores were to be found on nearly all of the spots. Similar acervuli appeared on spots on the fruit-stems and pedicels; also, on circular dead brown spots on the leaves. The disease was so virulent that only a few of the fruits matured and the trees were almost completely defoliated. The writer is of the opinion that the fungus on the fruit and fruit-stems was the same as that on the leaves and referable to *Cylindrosporium padi* Karst. It appears that the occurrence of this fungus on cherry fruit is unusual, although it is exceedingly common on cherry leaves, and the writer has observed the fruit pedicels of sour cherries abundantly infested with it.[28] A fungus causing a strikingly similar disease

[27] Museum Specimen No. 136.
[28] Stewart and Eustace (149, pp. 85–87).

of the green fruits of the European bird cherry, *Prunus padus*, in Europe has been named *Cylindrosporium tubeufianum* by Allescher;[29] but Aderhold,[30] upon making a careful comparison, failed to find any essential difference between *C. tubeufianum* and *C. padi*. Probably, the former name is to be considered a synonym of the latter.

CHESTNUT.

Castanea dentata.

Canker, *Valsonectria parasitica* (Murr.) Rehm. An excellent example of the manner in which the fungus gains entrance through wounds in the bark was observed at Hicksville in October, 1909. The trunks of two small chestnut trees crossed in such manner that they touched at one point. The swaying of the trees by the wind caused a slight abrasion of the bark on both trunks at the point of contact. Each tree showed a large canker centering about the abraded spot and these were the only cankers to be found anywhere on either trunk. The Valsonectria was in the ascosporic stage.[31]

CHRYSANTHEMUM.

Chrysanthemum sp.

Black speck, *Pilobolus crystallinus* (Wigg.) Tode. In December, 1909, we received from Lockport some chrysanthemum leaves covered with small round black specks.[32] The sender stated that the greenhouse containing the affected plants had been recently fumigated by burning tobacco stems. He wished to know why the smoke had settled on the leaves in this manner, since such spotting of the foliage was very objectionable.

The black specks were plentiful on both surfaces of the leaves. They were readily visible to the unaided eye. Under a hand lens they resembled in a striking manner the pycnidia or perithecia of some fungus. When examined with a compound microscope they appeared as circular black bodies 300–500 μ in diameter, often

[29] von Tubeuf (159, p. 504).
[30] Aderhold (1, p. 808).
[31] Museum Specimen No. 96.
[32] Host Herbarium Specimen No. 21.

bearing a few short brown appendages. The black bodies contained multitudes of elliptical, non-septate, slightly yellowish spores measuring 6 x 10 μ. Seen in mass, the spores appeared distinctly yellowish-brown.

The sender was informed that the black specks were the sporangia (spore masses) of *Pilobolus crystallinus,* a fungus which grows on fresh manure everywhere. The sporangiophores are provided with a mechanism which throws off the ripe spores with so much force that they are carried a distance of a meter or more. Being covered with a mucilaginous substance they readily adhere to whatever they strike — leaves, wood-work or glass.

Subsequently, it was reported to us that it was cow manure which had been used in the above-mentioned case; that the trouble appeared from three to five days after the application of the manure; and that the spore masses were thrown about 120 cm. (four feet).

Owing to the frequent use of fresh manure about roses under glass it is on rose leaves that the Pilobolus sporangia most frequently attract attention. Their occurrence on rose leaves has been recorded by Craig,[33] who states that the trouble was promptly arrested by a light application of air-slaked lime; by Stone and Smith,[34] who have illustrated the fungus and explained the method by which the sporangia are abjected; and by Halsted,[35] who observed sporangia thrown to a distance of ten feet. An amusing explanation of the origin of the black specks is given by May,[36] a florist, who states that they are due to the condensation of ammonia arising from fresh manure. Even professional mycologists have been deceived by them. According to Farlow,[37] the fungus bodies described by Peck[38] as parasitic on rose leaves under the name *Leptothyrium chromospermum* were, in reality, the discharged sporangia of *Pilobolus.*

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[33] Craig (23, p. 118). The fungus is called "Mucor," but this is plainly an error. The description given shows that the fungus was Pilobolus.
[34] Stone and Smith (153).
[35] Halsted (55, p. 333).
[36] May (81).
[37] Farlow (36).
[38] Peck (93).

CLEMATIS.

Clematis sp.

Leaf-spot, *Cylindrosporium clematidis* E. & E. var. *jackmanii* E. & E. The Host Herbarium contains specimens[39] which appear to belong to the same collection as the specimens upon which Ellis and Everhart[40] based their description of the var. *jackmanii*.

Specimens of the same fungus collected by S. A. Beach[41] are accompanied by the following note signed by Prof. Beach:— "On different varieties of clematis in the propagating houses of Selover and Atwood, Geneva, N. Y. Not doing serious damage, but causing the loss of a few lower leaves from many plants. April 10, 1893."

COREOPSIS.

Coreopsis tinctoria.

Powdery mildew, *Erysiphe cichoracearum* DC. On September 15, 1899, some plants of *Coreopsis tinctoria* growing on the Station grounds were found to be affected with a powdery mildew which proved to be *Erysiphe cichoracearum*.[42] On a few of the plants perithecia were numerous on both stems and leaves. Such of the perithecia as were mature contained several two-spored asci. *E. cichoracearum* occurs on many species of plants, but we are unaware of its having been reported previously on any species of Coreopsis.

COSMOS.

Cosmos bipinnatus.

Fasciation. In December, 1907, a single branch of a cosmos plant growing in the Station greenhouse showed a pronounced case of fasciation. It was about 25 mm. wide, leafy throughout and bore two normal flowers.[43]

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[39] Host Herbarium Specimen No. 22.
[40] Ellis and Everhart (33, p. 155).
[41] Host Herbarium Specimen No. 23.
[42] Host Herbarium Specimen No. 24.
[43] Host Herbarium Specimen No. 25.

Powdery mildew, *Erysiphe cichoracearum* DC. In 1899 and 1907 cosmos plants in the Station greenhouse were severely attacked by *Erysiphe cichoracearum* DC. Another, milder, attack occurred in the autumn of 1909, when plants in the open as well as those under glass were affected.

In 1907, traces of mildew appeared November 4. On November 29 a few mature perithecia were found. By December 11 the leaves and smaller branches of the plants were completely overrun with mildew. On branches, it rarely occurred on those over 6 mm. (one-fourth inch) in diameter. Perithecia were plentiful on leaves, branches, involucral scales and especially on the flower pedicels.[44]

In 1909, no perithecia could be found on the plants in the open until after October 6, but by October 28 mature perithecia were abundant. As a rule, the asci contained two sporidia each, but a few three-spored asci were found.

Apparently, the only previous reference to a powdery mildew on cosmos is found in a single sentence by Halsted, who says:[45] "A mildew (*Erysiphe cichoracearum*) so abundant upon many other of the Compositæ is frequently seen upon the foliage of the cosmos."

Stem blight, *Phomopsis stewartii* Pk. The present literature of this disease consists of a popular account by Halsted,[46] a note by Halsted[47] on a spraying experiment in which eight applications of bordeaux failed to prevent it, and a note by Clinton[48] on its occurrence in Connecticut. Our own studies upon it have been conducted intermittently from 1899 to the present time. In 1901 and 1902 Prof. H. J. Eustace, then Assistant Botanist of this Station, made cultural studies of the causal fungus and some inoculation experiments. Each year since 1899 the disease has regularly made its appearance among cosmos plants grown at the Station. Generally, it has attacked the plants both in the field and in the greenhouse and caused much damage.[49]

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44 Host Herbarium Specimens Nos. 26 and 27.
45 Halsted (52, p. 464).
46 Halsted (52). See also Halsted (53, p. 371).
47 Halsted (54, p. 400).
48 Clinton (20, p. 318).
49 Host Herbarium Specimens Nos. 28 and 29.

Stem blight is a disease of mature cosmos plants. Young plants are not affected. August 23 is the earliest we have known it to appear. It is most destructive in the greenhouse, but plants blooming in the open may be severely attacked during September and October. The point of attack may be anywhere on the stem or branches, but never on the leaves or roots. First, there appears on the green stem a brown spot which rapidly enlarges until it nearly or quite encircles the stem. A section of the stem several inches in length becomes involved. Then the parts above suddenly wilt and die. The diseased section of the stem is hollow, while above and below the point of injury the stem is nearly or quite solid, the pith being firm, green and water soaked.

The bark and pith are thoroughly permeated by fungus hyphæ. In the cavity formed by the disintegration of the pith, hyphæ are frequently so abundant as to be readily visible to the unaided eye. On the surface of the stem small pycnidia appear in great abundance. The pycnidia contain two kinds of spores — filiform, hyaline spores curved at one end like a fish hook, and oblong, binucleate, hyaline spores measuring about 3 x 10 μ. The existence of two kinds of spores was discovered by the writer in 1899 and has been observed repeatedly since. It is a regular occurrence. Sometimes one spore form predominates, sometimes the other. Even with a good hand lens we have been unable to distinguish the pycnidia containing one kind of spores from those containing the other kind. By means of sections it was learned that the two kinds of spores frequently occur in the same pycnidium. At first, it was suspected that the two kinds of spores belonged to two separate species of fungi, one of which was parasitic upon the other. But, subsequently, it was conclusively proven, by means of pure cultures, that they belong to one and the same fungus. Some difficulty was experienced in obtaining pure cultures of the fungus. It does not grow well on potato agar. The best success was secured with unneutralized alfalfa agar and sterilized alfalfa stems. On both these media it grows and fruits readily, producing both kinds

of spores. In our cultures, the oblong spores have been the first to appear.

That the fungus is a parasite and the cause of the disease there can be no doubt. This is shown by its constant association with the disease at the seat of the trouble while wholly absent from other dead parts of the plant. In ten years' study of the disease we have never found any other fungus in connection with it. Nevertheless, it appears to be somewhat difficult to reproduce the disease by artificial inoculation, either with pure cultures of the fungus or with bits of diseased tissue. Both methods have been tried by Prof. Eustace and also by the writer without any definite success. In such experiments there have been several instances in which a natural infection, occurring lower down, has killed the inoculated branch before the appearance of any discoloration of the bark at the point of inoculation notwithstanding the branch was apparently unblemished at the time of making the inoculation.

Halsted, who seems to have observed only the filiform spores, referred the fungus to the genus Phlyctæna. Taken by itself, the form with oblong spores is referable to the genus Phoma. But the occurrence of the two spore forms together in the same pycnidium complicates things so much that the writer found it necessary to refer the matter to an expert systematist. Accordingly, specimens were submitted to Dr. C. H. Peck, who has named the fungus *Phomopsis stewartii* and described it as follows:[50] "Perithecia gregarious, commonly occupying grayish or brown spots, thin, subcutaneous, at length erumpent, depressed, minute, $\frac{1}{3}-\frac{1}{2}$ mm. broad, black; spores of two kinds, first, filiform, curved, flexuous or uncinate, hyaline, $16-25 \times 1-1.5\ \mu$, second, oblong or subfusiform, hyaline, commonly binucleate, $8-12 \times 2-3\ \mu$; sporophores slender, equal to or shorter than the spores."

[50] Peck (102, p. 27).

COTTONWOOD.
Populus deltoides.

Yellowing and premature falling of leaves. The following observations were made on two cottonwood trees standing close beside a small stream on the Station grounds. One tree was eleven inches in diameter, the other, nine. Almost every year the stream goes dry for a short time during midsummer. In 1909 it was dry longer than usual — from July to October — owing to a severe drought. During the early part of September many of the leaves on these trees became yellow and fell to the ground before there had been any frost. By September 10th about one-half of the leaves were golden yellow while the remainder were normally green. All leaves were either bright yellow or green — there were none partly green and partly yellow. The green leaves were those toward the ends of the branches. On the following day (September 11) there came a drizzling rain and the yellow leaves fell in showers. The fallen leaves were free from spots and browning. The only blemishes about them were conspicuous insect galls occurring on the petioles of a considerable number of the leaves. These galls were of two kinds, caused by two species of Pemphigus, *P. populicaulis* and *P. populi-transversus*.[51] But it was plain that the galls had nothing to do with the yellowing of the leaves, for they were equally abundant on the green leaves. In the course of a few days the remaining leaves turned yellow and fell. Other cottonwood trees in the vicinity, particularly small trees on the banks of the stream, were similarly affected.

This seems to have been a case of premature ripening brought about by the drought and the drying up of the stream. Probably, the trees were not much injured. They appeared normal the following season.

In the spring of 1910 the larger tree was cut down. On the other tree, yellowing of the leaves did not commence until October 7. This year there was plenty of rain during the summer and fall and no frost until October 12.

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[51] Identified by H. E. Hodgkiss.

CUCUMBER.
Cucumis sativus.

Powdery mildew, *Erysiphe cichoracearum* DC. ? As a greenhouse trouble, cucumber powdery mildew is probably not uncommon. In 1891 it was observed by Bailey on greenhouse cucumbers at Ithaca[52] and the writer has personal knowledge of its destructive occurrence in certain greenhouses at Irondequoit in 1900, 1902 and 1905. The writer[53] has also reported its occurrence on field-grown cucumbers at Athens, Pennsylvania, in 1899, but, in New York, we have never known it to attack plants in the open until 1909.

In 1909, Mr. C. R. White, Ionia, N. Y., sent us some leaves of field-grown cucumbers affected with powdery mildew. He stated that his entire field of nine acres had been considerably injured by it; also, that other fields in the vicinity were affected. The leaves sent showed no perithecia. In fact, the writer has never seen perithecia on cucumber leaves. Hence, the fungus can not be identified with certainty, but it is probably *Erysiphe cichoracearum*. Perithecia found by Humphrey[54] on greenhouse cucumbers in Massachusetts belonged to this species and Reed's cross-inoculation experiments with *E. cichoracearum* show that it grows readily on cucumber leaves.[55]

DAHLIA.
Dahlia varabilis.

Powdery mildew, *Erysiphe cichoracearum* DC. This fungus was found in considerable abundance on the leaves and stems of cultivated dahlias at Cutchogue, Long Island, in October, 1909. Mature perithecia were plentiful on both surfaces of the leaves and also on the stems.[56] It has been reported on cultivated

[52] Humphrey (62); Bailey (11, p. 138).
[53] Stewart (140, p. 213).
[54] Humphrey (63 and 64).
[55] Reed (107).
[56] Host Herbarium Specimens Nos. 30 and 31.

dahlias in Ohio by Selby and in Connecticut by Clinton. Another powdery mildew, *Erysiphe communis* (Wallr.) Fr. (= *E. polygoni* DC.) has been reported by Tracy and Galloway[57] as occurring on dahlias in Missouri.

GRAPE.
Vitis spp.

Powdery mildew, *Uncinula necator* (Schw.) Burr. F. L. Stevens has described and illustrated the curious instance of some grape leaves on which the tortuous trail of some small animal was plainly marked by a growth of the white mycelium of *Uncinula necator*. Stevens' observations were made at Columbus, Ohio, in September, 1898.

The same thing was observed by the writer at Geneva, N. Y., September 13, 1898.[59] In this case, the grape was of the variety Wilder and growing against the north side of a house. For the most part, the mildew grew only on the track of the animal (Plate IV), but on some of the affected leaves there were also circular mildew spots of the normal kind. Ripe perithecia were found and these showed the mildew to be *Uncinula necator*. The mildew was freely parasitized by *Cicinnobolus cesatii* DeBy. Ten years later (1908) the phenomenon was observed a second time on the same grape vine. We have seen, also, specimens collected at Fredonia, N. Y., in 1909, by F. Z. Hartzell.

Stevens did not learn the identity of the animal. He suggested that it may be a worm or snail which crawls over the leaf, leaving behind it a trail of its glutinous secretion. He states that "sections show the track to be purely superficial." This appears to be an error. Observations made by Mr. F. Z. Hartzell, Assistant Entomologist of this Station, show that the track is made by a leaf-mining larva working under the upper epidermis of the

[57] Tracy and Galloway (158).
[58] Stevens (136).
[59] Host Herbarium Specimen No. 32.

leaf.[60] Mr. Hartzell's studies were made in Chautauqua County, but the writer has seen his specimens and is convinced that they are identical with those found at Geneva and, probably, also with those studied by Stevens.

To account for the peculiar distribution of the fungus Stevens advances the theory that spores of the fungus are scattered by the animal. Such can scarcely be the case, because it is probable that the larva making the mine enters the leaf as soon as it is hatched and so has no opportunity of getting the spores onto its body. To the writer it appears plain that the fungus finds more favorable conditions for its growth along the trail of the larva than on the uninjured tissue bordering the trail; but why this is so is not clear. It is difficult to explain why a strict parasite (which this fungus is supposed to be) should prefer injured tissue.

Bordeaux injury. The following observation indicates that the variety Cottage is more liable to bordeaux injury than the variety Delaware. A vineyard at Highland contains several rows in which some of the plants are of the Cottage variety while others are Delawares. In the spring of 1909, just before blooming, these rows were sprayed with bordeaux mixture each fifty gallons of which contained five pounds of copper sulphate and sufficient lime to satisfy the potassium ferrocyanide test. When the writer examined the vineyard on June 17 the Cottage plants

[60] The insect referred to above is the larva of a Tineid moth bearing the name *Phyllocnistis vitigenella* Clemens. The moth is silvery white with a black spot and several lines near the distal end of the wing. It has an alar expanse of five millimeters. The larva makes a serpentine mine underneath the upper epidermis of the leaf by feeding on the palisade cells and perhaps on a few cells of the spongy parenchyma, but does not eat through to the lower epidermis. For this reason the mine is not transparent and the drying of the epidermis causes the mine to have the appearance of a snail's track. Chambers' statement (19, p. 192) that "the larva hardly burrows through the cuticle, and does not go down into the parenchyma" is incorrect. The sub-epidermal character of the mine is difficult to demonstrate by free-hand sections, but the presence of an epidermis over the mines is proven by the fact that it can be lifted by means of a dissecting needle.

The moths and their mines were quite numerous on Concord grape leaves during the summers of 1909 and 1910 at Fredonia, N. Y. Pupæ were taken from July 20 to August 23 and the adults emerged from July 22 to September 16. The adults are said to hibernate under the rough bark of trees and perhaps in other secure hiding places. Only one larva was taken.—F. Z. Hartzell.

were showing considerable spray injury which manifested itself in the form of large, irregular dead brown areas on the leaves. At the same time the foliage of the Delawares was perfect.

HEPATICA.

Hepatica acutiloba.

Downy mildew, *Plasmopara pygmæa* (Ung.) Schrt. A resident of Geneva has a bed of *Hepatica acutiloba* planted in a thicket of small trees in his yard. In May, 1909, he called the writer's attention to a disease which was ruining the foliage of the Hepatica plants. He stated that the plants had been similarly affected the preceding season. Upon examination it was found that the trouble was due to the fungus *Plasmopara pygmæa*[61] which was so abundant that nearly all of the leaves were killed by it before June 1.

In the spring of 1910 the disease reappeared. Our first observations were made on April 8th, at which time the plants were already in full bloom, the spring being unusually early. The majority of the plants then appeared healthy, but there were a few the leaves of which were dwarfed and distorted and covered with Plasmopara conidia. On June 13th affected leaves were showing large, irregular, dead, brown (sometimes yellowish) areas. Oöspores, 14–17μ in diameter, were now plentiful.[62] This season the disease was much less destructive than in 1909, owing, probably, to the plants having been sprayed twice with bordeaux mixture.

The owner informs us that the plants in this bed were taken, a few years ago, from another bed less than 100 feet distant on the opposite side of his yard. It is an interesting fact that not even a trace of the disease has ever appeared on any of the plants in the parent bed, notwithstanding they are in the shade and otherwise treated in essentially the same manner as the plants in the diseased bed. From this it appears that the disease does not

[61] Host Herbarium Specimen No. 33.
[62] Host Herbarium Specimen No. 34.

spread readily. Prof. Whetzel is of the opinion that the fungus perpetuates itself by means of a perennial mycelium as well as by oöspores.[63]

HOLLYHOCK.

Althæa rosea.

Rust, *Puccinia malvacearum* Mont. This is a common and often destructive disease of hollyhocks in New York. In October, 1909, the writer's attention was attracted by the peculiar appearance of some rust-infested leaves of hollyhocks growing on the Station grounds.[64] Viewed from the upper surface the affected leaves showed small, white, slightly sunken spots about one millimeter in diameter. With the aid of a hand lens a few small, black pycnidia could be seen on some of the spots. The majority of these pycnidia proved to be those of an Ascochyta, but some were Septoria pycnidia. On the under surface of the leaf opposite the white spot, there was invariably a rust sorus. Apparently, the Ascochyta and Septoria were growing parasitically upon the Puccinia.

On April 21, 1910, further observations were made on the same plants. Already, the leaves were thickly covered with rust sori. Some of the lower leaves showed conspicuous brown spots, each of which had a stunted rust sorus in the center on the under side of the leaf. No trace of Ascochyta or Septoria could be found

[63] In a letter dated Oct. 8, 1910, he says:—"My opinion as to the perennial habit of the mycelium of *Plasmopara pygmæa* (Ung.) Schrt. is based upon observations covering several years and also upon an experiment which I carried out for the past three years. Having frequently observed that individual plants here and there in a large hepatica patch in the forest were affected with this mildew and that the parasite not only seemed to infest the entire plant but did not seem to spread to any great extent to the neighboring plants, I took up several of these diseased plants, and transplanted them to a shady spot in my garden. This was in the spring of 1907. The diseased leaves soon died down after transplanting. The next spring, the roots sent up leaves again, which, *as soon as they appeared*, showed that they were diseased, being small, distorted, and covered with conidiophores in a very short time after they appeared. Practically every leaf on the plant was diseased. In the spring of 1909 and 1910, only a few leaves appeared from the roots. These were likewise diseased and died down quickly. It appears that the disease slowly kills the plant. From this it seems almost certain that the mycelium must be perennial in the roots of the plant."

[64] Host Herbarium Specimen No. 35.

at this time. By June 2d, the dead brown spots had become numerous. They were circular, 3 to 6 mm. in diameter and sharply defined.[65] The central portion was slightly sunken but not white. Occasional spots bore pycnidia of the Septoria observed in 1909. Other spots bore pycnidia of a Phyllosticta. Occasionally, rust sori on the leaf petioles were surrounded by pycnidia of Ascochyta in exactly the same manner that pycnidia of *Darluca filum* are associated with the rust sori parasitized by it. However, the spores of the Ascochyta are broadly rounded at both ends and commonly measure 4 x 10 μ while those of *Darluca filum* are distinctly fusoid and measure 4 x 17 μ. The Septoria spores are usually three-septate and measure 3.5–4 x 30–45 μ.

The Ascochyta is probably *A. parasitica* Fautrey and the Septoria, *S. parasitica* Fautrey. Fautrey[66] has observed a similar association of these fungi with *Puccinia malvacearum*. Clinton[67] also, states that, in Connecticut, *Ascochyta parasitica* occurs on hollyhock leaves associated with rust pustules.

At least two other species of Septoria occur on Malvaceæ in New York; namely, *S. malvicola* E. & M.[68] on *Malva rotundifolia* and *S. fairmani* E. & E.[69] on hollyhock leaves; but both of these have narrower spores and produce spots of a different character. *Septoria parasitica* Hartig, which causes a twig blight of spruces in Europe, now bears the name *Ascochyta pinniperda* Lindau.[71]

HONEYSUCKLE.

Lonicera tatarica.

Powdery mildew, *Microsphæra alni* (Wallr.) Salm. var. *lonicerae* (DC.) Salm. Salmon says:[72] "The var. *lonicerae* is confined to Europe; the numerous records of the plant on species

[65] Host Herbarium Specimen No. 36.
[66] Fautrey (37).
[67] Clinton (20, p. 326).
[68] Martin (79, p. 65).
[69] Ellis and Everhart (33, p. 151).
[70] Hartig (56).
[71] Lindau (73).
[72] Salmon (116, p. 145).

of Lonicera in America all refer to typical *M. alni.*" Considering this statement it is worthy of note that specimens of the var. *lonicerae* on leaves of Tartarian honeysuckle were collected by the writer at Geneva in September, 1909.[73] Our determination of the fungus has been confirmed by Dr. Salmon to whom specimens were sent for examination. Sixteen affected plants were found, most of them well covered with mildew, particularly on the lower leaves, but apparently none were materially injured. Twelve of the plants were scattered through a small park while the other four were in neighboring yards. Thirteen of the affected plants bore yellow fruits and the other three red fruits. Apparently, the yellow-fruited varieties are much more susceptible to mildew than is the red-fruited one. When the plants bloomed in the spring of 1910 some of the yellow-fruited ones bore white flowers (var. *alba*), while others bore light pink flowers the lobes of which were bordered with white (var. *latifolia?*). The red-fruited plants produced deep pink flowers with lobes bordered with white (var. *speciosa?*). The mildew occurs chiefly on the upper surface of the leaves, but to some extent also on the under surface. In September ripe perithecia were numerous and readily visible to the unaided eye. They are considerably larger than the perithecia of *M. alni* on lilac leaves.

In 1910, twenty-eight mildewed plants were found. The mildew commenced to appear about July 1st and by August 20th perithecia were plentiful. In one case, perithecia were found on some shriveled yellow fruits.

HOP.

Humulus lupulus.

Leaf-spot, *Cylindrosporium humuli* E. & E. Specimens of this on leaves of cultivated hops were collected at Oaks Corners, September 5, 1900.[74] The hop plants were but slightly injured. Other specimens were taken at Middleburgh in August, 1910.

[73] Host Herbarium Specimens Nos. 37 and 38.
[74] Host Herbarium Specimen No. 39.

Powdery mildew, *Sphærotheca humuli* (DC.) Burr.[75] During the latter part of August, 1909, hop growers in the vicinity of Waterville, N. Y., became alarmed over an outbreak of a hop disease which they called "blue mold." On September 4th the writers visited Waterville for the purpose of investigating the trouble.[76] It was found that the so-called blue mold was, in reality, a powdery mildew.[77] In one hop-yard of about four acres the crop was a total loss because of the disease. A few other yards were slightly injured. In the worst-affected yard the hops were of the Canada variety. This variety appeared more susceptible to attack than the English Cluster variety. The leaves, stems and cones were covered with a conspicuous whitish mildew. The favorite point of attack of the fungus seemed to be on the pedicel at the base of the cone. Usually, the bracts of the cone were not mildewed except at the base, but the tips of the bracts were brown and shriveled. This gave the cones a brown, scorched appearance. Also, the affected cones were much smaller than healthy ones. (Plate VI.) Apparently, the browning and dwarfing of the cones resulted from the attack of the fungus on the bracts and pedicels of the cones rather than from the attack on the leaves. Most of the foliage was but slightly mildewed. Surely the mildew was not sufficiently abundant on the foliage to cause serious injury by reducing the vitality of the plant. However, occasional branches here and there were white with mildew and many leaves were more or less spotted by it. On the leaves, the mildew appeared in conspicuous bluish-white spots and blotches or frequently covered them completely. (Plate V.) It occurred most abundantly on the upper surface of the leaves, but also on the under surface. On the cones, it was not conspicuous except on very small ones which were sometimes completely overgrown with mildew. In some cases of mild attack it was necessary to use a hand lens to distinguish diseased cones from healthy ones. The cone-pedicel and cone-axis are covered normally with a fine white pubescence closely resembling mildew.

[75] By F. C. Stewart and H. H. Whetzel.

[76] Brief accounts of the observations made during this visit have been published previously. See Stewart (145) and Whetzel (162).

[77] Host Herbarium Specimens Nos. 40 and 41.

Although a careful search was made for them, no perithecia were found. Hence, the fungus could not be identified with certainty. Three species of powdery mildew are said to attack hops — *Erysiphe cichoraccarum*,[78] *Phyllactinia corylea*[79] and *Sphærotheca humuli*. The first two species are of rare occurrence on hops, but *Sphærotheca humuli* is a widely distributed and well-known hop parasite.

Contrary to our expectations, the mildew reappeared at Waterville in 1910 and became considerably more destructive than in 1909. Messrs. Jensen and Blodgett[80] of the New York State College of Agriculture, who went to Waterville to study the disease, report finding perithecia of *Sphærotheca humuli*. This definitely identifies the mildew occurring there as the dreaded "hop mould" or "hop mildew" of England.

On August 24, 1910, the senior author and G. G. Atwood of the State Department of Agriculture visited Middleburgh to investigate an outbreak of the mildew at that place. All hop yards in the vicinity of Middleburgh were found to be more or less affected. In some cases the loss was estimated at from 65 to 80 per ct. It is reported that the mildew appeared also at Sharon Springs and various places in Otsego County. At Middleburgh the behavior of the disease was essentially the same as at Waterville in 1909 with two exceptions, viz.: (1) Perithecia of *Sphærotheca humuli* were abundant on stems, leaves and cones;[81] (2) The Canada and English Cluster varieties appeared about equally susceptible.

Hop growers, knowing the damage done by this disease in England, fear that it may become common and destructive here. This may or may not happen. It is encouraging to note that although its occurrence on hops has been reported, occasionally, from Maine[82] to California[83] there is no record of its having caused

[78] Tracy and Galloway (158).
[79] Magnus (76).
[80] Jensen and Blodgett (67).
[81] Host Herbarium Specimen No. 42.
[82] Harvey (58, p. 50).
[83] Burrill (16, p. 5) says: "In California Dr. Harkness reports *S. castagnei* on hop leaves. This is no doubt what is here called *S. humuli*."

serious damage anywhere in America. Burrill[84] says that *S. humuli* "is a very destructive parasite, especially on cultivated hops, in the Old as well as in the New World," but he gives no details. In this connection a bit of information furnished us by Dr. B. M. Duggar is of special significance, viz., that he observed a powdery mildew on hops at Waterville about ten years ago, yet no serious outbreak of the disease followed. No other instance of the occurrence of mildew on hops in New York prior to 1909 is known to us.

Why the hop mildew should not be destructive in this country is not clear. The climate of England is moister than ours, but it is worthy of note that the seasons of 1909 and 1910 in which the Waterville and Middleburgh outbreaks occurred were exceptionally dry seasons.

In England, one of the chief methods of combating mildew consists in dusting the plants with flowers of sulphur on hot, sunshiny days.[85] Potassium sulphide solution, applied in the form of spray, has also been used. Percival[86] recommends potassium sulphide spray followed by an application of powdered sulphur. In bearing hop yards all parts of the plants above ground should be burned as soon as the crop is gathered; while young plants, not in bearing, should be left to continue their growth until killed by frost and then burned.[87]

HORSE CHESTNUT.

Aesculus hippocastanum.

Ragged leaves, *frost injury.* Sorauer seems to have been the first to give (in 1903) the correct explanation of the ragged con-

[84] Loc. cit. p. 6.

[85] Whitehead (164, pp. 246–249).

[86] Percival (103, p. 734).

[87] Since *S. humuli* attacks also various species of wild plants it generally has been recommended that treatment for mildew include the destruction of susceptible weeds in and about the hop yard; but cross-inoculation experiments made by Salmon indicate that this is unnecessary. Salmon says (117, p. 332): "The whole of the evidence to hand strongly supports the view that hop 'mould' is due to one special 'biologic form' confined to *Humulus lupulus* and *H. japonicus* and that consequently hop growers have nothing to fear from other forms of *S. humuli* growing on wild plants." However, he points out that the matter cannot be considered fully settled until inoculation experiments have been made on all of the 30 or more host plants of *S. humuli.*

dition so common with horse chestnut leaves. (Plate VII.)[88] He ascribed it to frost injury while the leaves are unfolding.[89] On the other hand, Thomas[90] has expressed the opinion that frost is secondary and that the primary and chief factor is the wind. Sorauer[91] answers this by pointing out that the lesions are not of the kind to be expected from wind injury, and that, moreover, he has seen the injury brought about by frost on trees fully protected from wind.

Our own observations indicate that the leaves of horse chestnut trees at Geneva are more or less injured by late spring frosts almost every year. It has occurred every spring during the past eight years—1903–10.

Since the injury occurs at the time the leaves are unfolding it seems desirable to give a description of horse chestnut buds and their manner of opening. Some horse chestnut buds contain both leaves and flowers; others only leaves. The former are considerably the larger and usually open earlier. There are generally six pairs of bud-scales arranged decussately. They are of different sizes - the lower, or outermost, pair being seven millimeters or less in length while the innermost are 25 to 50 mm. long. On the outside they are covered with a sticky substance. The second pair of scales often separate widely from the bud while the upper four pairs are still tightly closed over the leaves. By the time the petioles and leaf blades are each 50 mm. in length the second and third pairs of scales are reflexed while the other pairs stand upright though divergent at their tips. At Geneva, the tips of the leaves begin to show the last week in April or the first week in May.[92] Some trees leaf earlier than others. A tree on the Station grounds regularly breaks its buds a few days earlier than other trees standing on either side of it. In

[88] Host Herbarium Specimen No. 43.
[89] Sorauer (131, 132 and 134, p. 533).
[90] Thomas (156).
[91] Sorauer (133).
[92] In the spring of 1910 horse chestnut trees began to show their leaves during the first week in April. As measured by the time of leafing of a certain horse chestnut tree on the Station grounds, the spring of 1910 was 24 days earlier than that of 1909.

1909 the difference was seven days. (Plate VIII.) Even on the same tree some buds break a week earlier than others. In the bud, each of the seven leaflets is folded by the midrib so that the two halves are placed face to face. On each side of the midrib the folding is fan fashion so that the large lateral veins are arranged in parallel lines on the outside and the folds of the intervening parenchyma inside. While in the bud, the leaves are thickly covered on the back and petioles with matted, woolly white hairs. When the bud breaks, exposing the leaves to the light, the hairs become light brown or tawny and gradually fall away as the leaves expand.

At Geneva, one or more light frosts occur between May 1st and 15th almost every year. Any time during this period a temperature of 31° F. or lower will cause injury to horse chestnut leaves. During the night of May 1, 1905, the self-registering maximum and minimum thermometer on the Station grounds registered 29.5° F. At this time horse chestnut leaves were breaking from the buds and showing 25 to 40 mm. (1 to 1.6 inches) of their tips. (Plate IX, fig. 1.) On May 5th the partially expanded leaves showed shiny, light-brown, water-soaked spots in the parenchyma between the veins. By May 12 some of the leaves were already showing the characteristic comb-like appearance. On May 15th the following observations were made: Where the injury was slight the spots were depressed, water-soaked in appearance and very shiny. Often they occurred in a straight line between the larger veins. Where the injury was more severe the spots were light brown with a yellowish margin; and where the injury was very severe the dead tissue had fallen completely away leaving irregular holes as clean cut as if made by some biting insect. In 1906, frost (30° F.) occurred on the night of May 10th when the blades of horse chestnut leaves were 50 to 125 mm. (2 to 5 inches) in length. The following morning at nine o'clock frost injury was evident. It appeared chiefly in the form of shiny, yellowish-brown, water-soaked spots which were slightly depressed and irregular in outline. The same symptoms were observed again on May 4, 1908,

the temperature having fallen to 31° F. during the night of April 30th and also during the night of May 3d. In all cases, the ultimate condition of the affected leaves is similar to that shown in Plate VII.

Trunk rot, ? *Collybia velutipes* Curt. A large horse chestnut tree in Geneva languished for two or three years and finally died in the spring of 1903. Apparently, the death of the tree was due to a fungus rot of the trunk. The only fungus fruit bodies observed were sporophores of *Collybia velutipes*[93] which appeared in November, 1902, while the tree was still living. Several large clusters of sporophores broke through the bark on the south side of the trunk at a hight of one to two meters (3 to 6 feet). *C. velutipes* is usually saprophytic, but there are reasons for believing that it may be, sometimes, a wound parasite which was, seemingly, the case here. Hennings[94] states that *C. velutipes* occurs on living trunks of horse chestnut and several other kinds of trees.

IVY, BOSTON.

Ampelopsis tricuspidata.

Leaf-spot, *Phyllosticta labruscæ* Thüm. In general, the Boston ivy in New York is exceptionally free from disease, but it is occasionally affected with a leaf-spot due to *Phyllosticta labruscæ*. The Station herbarium contains specimens collected at Floral Park in July, 1902, and at Ossining in June, 1907.[95] Peck[96] has reported it from Menands, N. Y. Thirteen years ago Halsted[97] reported the same disease from New Jersey, using the name *Phyllosticta ampelopsidis* E. & M., which is now regarded as a synonym of *P. labruscæ*. It forms circular dead brown spots 2–7 mm. in diameter.

P. labruscæ is the pycnidial form of the grape black rot fungus *Guignardia bidwellii* (Ell.) Viala & Ravaz.

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[93] Identified by G. F. Atkinson.
[94] Hennings (61).
[95] Host Herbarium Specimens Nos. 44 and 45.
[96] Peck (101, p. 31).
[97] Halsted (54, p. 410).

LILY, BLACKBERRY.

Belamcanda chinesis.

Leaf spot, *Heterosporium gracile* (Wallr.) Sacc. Some plants of the blackberry lily growing on the Station grounds in 1903 were severely attacked by this fungus during August. The upper portions of the leaves became brown and withered owing to the presence of numerous circular dead spots caused by the fungus.[98]

MAPLE, NORWAY.

Acer platanoides.

Ragged leaves, *frost injury.* Each spring since 1903 the writer has made observations on the effect of late spring frosts on Norway maple foliage. The conclusion reached is that the raggedness of the early-formed leaves of Norway maple, occurring in New York more or less abundantly almost every season, is chiefly due to frost injury at time of leafing. We refer to the condition in which the leaves show numerous, irregular holes of various sizes. (Plate X.) In 1904 such injury was very common, owing to the frost which occurred on the night of May 10th, and it seems to have been the popular opinion that the holes were caused by some insect. This is not strange because the clean-cut, irregular holes closely resemble the work of biting insects.

Instead of being arranged in rows as on horse chestnut leaves (Plate VII) the holes are distributed irregularly over the leaf. This difference is due to the differences in venation in the two kinds of leaves.

Norway maple buds usually open at about the same time as horse chestnut buds, which, at Geneva, is about May 1st. As with the horse chestnut, the time of leafing varies slightly with the season.[99] In the bud, the leaves are folded fan-fashion so

[98] Host Herbarium Specimen No. 46.

[99] In this connection it is interesting to note that, in 1909, horse chestnut leaves appeared about three days earlier than on the same tree in 1905; while Norway maple leaves appeared about five days *later* in 1909 than on the same tree in 1905. There can be no doubt as to the accuracy of these observations. Neither were there any inequalities of environment which

that the principal veins are on the outside and the parenchyma inside. Under a hand lens they appear to be thickly covered with glistening, roundish, translucent bodies. These are the heads of short-stalked, capitate plant hairs which constitute the sole protection of the unfolding leaves. They occur on the petioles and leaf blades; also, sparingly, on flower peduncles.

Dropping of leaves in June, *Aphids.* During the last week of June, 1903, Norway maples along the streets of Geneva dropped large numbers of their leaves. Under some trees they were so numerous that the ground was nearly hidden by them. A striking feature of the fallen leaves was their freedom from brown spots and blemishes. Although somewhat dry and papery they retained their green color for several days after falling. It seemed strange that such healthy-appearing leaves should fall.

However, the cause was not difficult to find. For some time previous the trees had been infested with aphids[1] which made their presence known by their honey dew. This made the leaves wet and sticky and spotted the walks beneath. While some trees infested by aphids were not dropping their leaves, the worst-infested trees dropped them most. Plainly, the aphids were the cause of the trouble. It was observed that they gathered in dense clusters around the base of the leaf petioles; also, the large veins appeared to be favorite feeding places for them.

In 1908, there was extensive dropping of Norway maple leaves from the same cause. In 1909, during a high wind on June

would account for the phenomenon. It seemed to be the general condition in 1909 that leafing was hastened in horse chestnut and retarded in Norway maple. To what extent such inversions in the relative order of leafing occur or how they are to be explained the writer does not know. Pfeffer (104, p. 212) states that "many of our flowers do not always bloom in the same order" and Prof. U. P. Hedrick, Horticulturist of this Station, informs us that certain varieties of plums do not always ripen in the same order. According to Jackson (65), Ralm has used the term "phenological inversion" to designate "an abnormal inversion of the relative blossoming of plants, caused by meteorologic conditions." It seems to the writer that the same term may be applied, with propriety, to the cases of abnormal leafing and ripening here mentioned.

[1] The species was not, at the time, identified; but Mr. P. J. Parrott, the Station Entomologist, informs us that the aphid commonly infesting Norway maple leaves is *Chaitophorus aceris* Linn.

20th, so many Norway maple leaves fell that the attention of many people was directed to the phenomenon, particularly in Canandaigua. Apparently, it is a common trouble.

MAPLE, SILVER.
Acer saccharinum.

Black spot, *Rhytisma acerinum* (Pers.) Fr. Mycological literature contains numerous references to the occurrence of *Rhytisma acerinum* on the leaves of Norway maple, *Acer platanoides*, and sycamore maple, *A. pseudoplatanus*. Hartig[2] even says that *A. platanoides* suffers especially from this parasite, *A. pseudoplatanus* and *A. campestre* in less degree.

Our own observations indicate that, in New York, *A. platanoides* is rarely if ever attacked by Rhytisma. *A. saccharinum* and *A. rubrum* are the maples commonly affected here. On October 21, 1909, the writer drove along the north shore of Long Island from Cutchogue west to a point north of Riverhead, a distance of nine miles. Throughout almost the entire distance the highway is lined with maples of three species — *A. saccharinum*, *A. platanoides* and *A. pseudoplatanus*. Of the first two species named, there are numerous specimens, but of the third species only an occasional tree. The trees were scanned for Rhytisma, the characteristic tar-colored spots of which may be detected at a considerable distance. Every tree of *A. saccharinum* was more or less affected with *Rhytisma acerinum*, some of them quite severely; while not a trace of the fungus was observed on any tree of the other two species.

This disease is much more common on Long Island than in any other part of the State.

MUSKMELON.
Cucumis melo.

Leaf-spot, *Septoria cucurbitaceaum* Sacc. About the middle of September, 1909, the writer found, in a garden at Fayette-

[2] Hartig (57, p. 98).

ville, some muskmeloon plants the leaves of which were considerably affected with a leaf-spot disease caused by *Septoria cucurbitaccarum* Sacc.[3] At first sight, the spots appeared to be of two kinds; (1) small, gray or whitish spots .5–2.5 mm. in diameter; (2) large, brown spots 3–6 mm. in diameter. But microscopic examination showed that the two kinds of spots were caused by the same fungus. Both bore pycnidia of *Septoria cucurbitaccarum* which appeared as minute black specks chiefly on the upper surface. Both kinds of spots were circular in outline, conspicuously visible on both surfaces of the leaf and frequently surrounded by a zone of yellowish-green color.

Apparently, this is an uncommon and probably unimportant disease of muskmelons. Its literature is meager. Although *S. cucurbitaccarum* has been reported as occurring in this State on the living leaves of pumpkin[4] and on the fruit of squash,[5] the writer is unaware of any previous record of its occurrence on muskmelon leaves in New York. Davis has noted its occurrence on leaves of shaded muskmelon plants at Racine, Wisconsin, in 1890.[6] A later collection made by Davis at Racine in 1905 was distributed as No. 2171 of Ellis and Everhart's Fungi Columbiani. In 1905, Delacroix published an account of the disease stating that he had received specimens from many localities in France.[7]

Other species of Septoria recorded on Cucurbitaceæ are: *S. vestita* B. & C., on fruit of Cucurbita, spores 12 μ long; *S. citrulli* E. & E., on leaves of *Citrullus vulgaris* (watermelon), spores 10–25 μ long; and *S. sicyii* Pk., on leaves of *Sicyos angulatus* (burr cucumber), spores 40–60 μ long. In our specimens of *S. cucurbitaccarum* the spores are 55–75 μ long and the pycnidia 85–120 μ in diameter.

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[3] Host Herbarium Specimen No. 47. Prof. H. H. Whetzel informs us that he, also, collected specimens of the disease near Syracuse in 1909 but in a different locality.

[4] Peck (92, p. 44).

[5] Peck (97, p. 118).

[6] Davis (24, p. 176). The date of collection is not given, but Dr. Davis informs us that it was Sept 12, 1890.

[7] Delacroix (25, pp. 168–170).

NASTURTIUM.
Tropæolum majus.

White rust, *Albugo candidus* (P.) Kze. On May 30, 1908, an Albugo, apparently *A. candidus,* was found on a few leaves of dwarf nasturtiums growing in two neighboring gardens in Geneva.[8] The sori formed circular white spots about 6 mm. in diameter on the under surface of the leaves. On the upper surface the location of the spots was marked by yellowish areas of indefinite outline. The globular, hyaline conidia measured 14–18 μ in diameter. No oöspores were observed.

It appears that this observation makes an addition to the already long list of host plants of *A. candidus.* At least *Tropæolum majus* is not included in Wilson's host-list which is supposed to be complete for North America.[9]

OAK, WHITE.
Quercus alba.

Spangle galls, *Cynips poculum* O. S. Although the insect troubles of plants do not properly come within the province of this bulletin, the following note on oak spangle galls is included for the information of plant pathologists who may be perplexed by them.

In August, 1900, Dr. S. A. Russell of Poughkeepsie sent us two oak leaves which were thickly covered, on the under surface, with peculiar saucer-shaped whitish bodies the nature of which we were at first unable to determine. On September 11, 1900, the writer, following directions given by Dr. Russell, visited the tree from which the specimens had been taken and made an examination of it. It was a magnificent white oak located at Clove, fifteen miles east of Poughkeepsie. It had a trunk four feet in diameter and a wide-spreading symmetrical top. Although almost every leaf bore large numbers of the saucer-shaped galls on the

[8] Host Herbarium Specimen No. 48.
[9] Wilson (165).

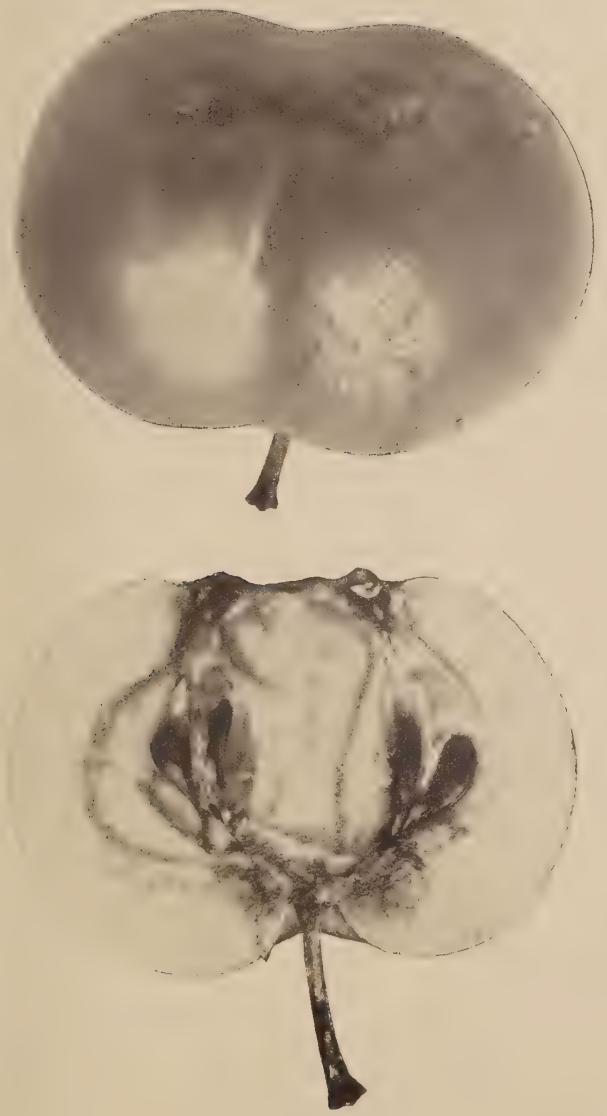

PLATE I.— A DOUBLE APPLE.
(Natural size.)

PLATE II.— SPOROPHORES OF *Fomes fomentarius* ON PROSTRATE BEECH TRUNK.
(From photograph by B. M. Duggar.)

PLATE III.— SPOROPHORES OF *Fomes fomentarius* WHICH CHANGED THEIR DIRECTION OF GROWTH.

1. On top of log. (One-half natural size.)
2. On side of log. (Natural size.)

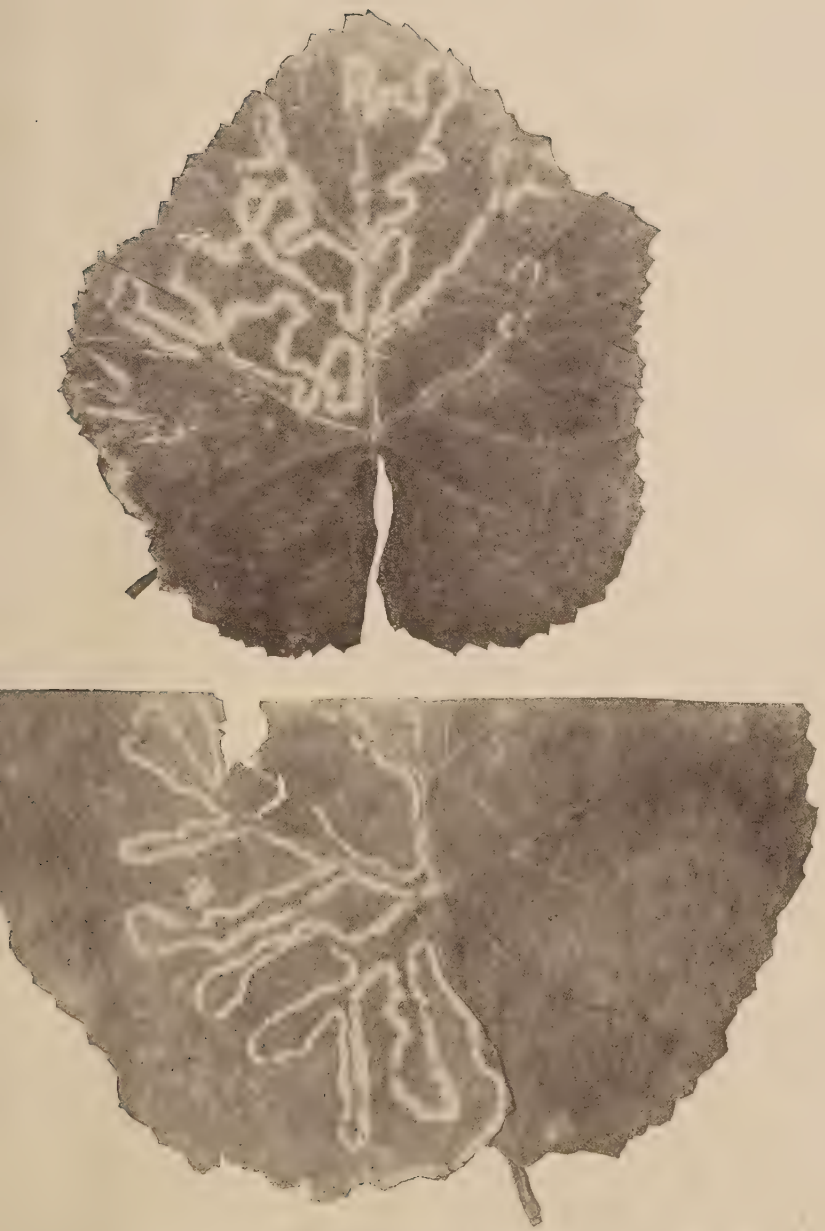

PLATE IV.—GRAPE LEAVES WITH POWDERY MILDEW GROWING ALONG THE PATH OF A LEAF MINER.
(Natural size.)

PLATE V.— HOP LEAVES ATTACKED BY POWDERY MILDEW, *Sphærotheca humuli.*

1
2

PLATE VII.— HORSE CHESTNUT LEAF INJURED BY SPRING FROST.
(One-half natural size.)

PLATE VIII.— AVERAGE CONDITION OF HORSE CHESTNUT BUDS APRIL 29, 1909.
1 and 2. Of trees on Station grounds. 3 and 4. Of an early-leafing tree.
Difference, about 7 days.
(Natural size.)

PLATE IX.— PARTIALLY OPENED BUDS OF HORSE CHESTNUT (1) AND NORWAY MAPLE (2).

Light frost at this stage causes the ragged leaves shown in Plates VII and X. (Natural size.)

PLATE X.—NORWAY MAPLE LEAVES INJURED BY SPRING FROST.
(Natural size.)

PLATE XI.— SPANGLE GALLS ON LEAVES OF WHITE OAK.
(Natural size.)

PLATE XII.— FRUITS OF KIEFFER PEAR ATTACKED BY RUST.
One fruit (the largest one) healthy; all others diseased.
(Natural size.)

PLATE XIII.— SHELDON PEAR STOCK WITH YEARLING SECKEL CIONS.
One cion failed because of canker on that side of the stock.
(1. One-third natural size; 2. Same stock, natural size.)

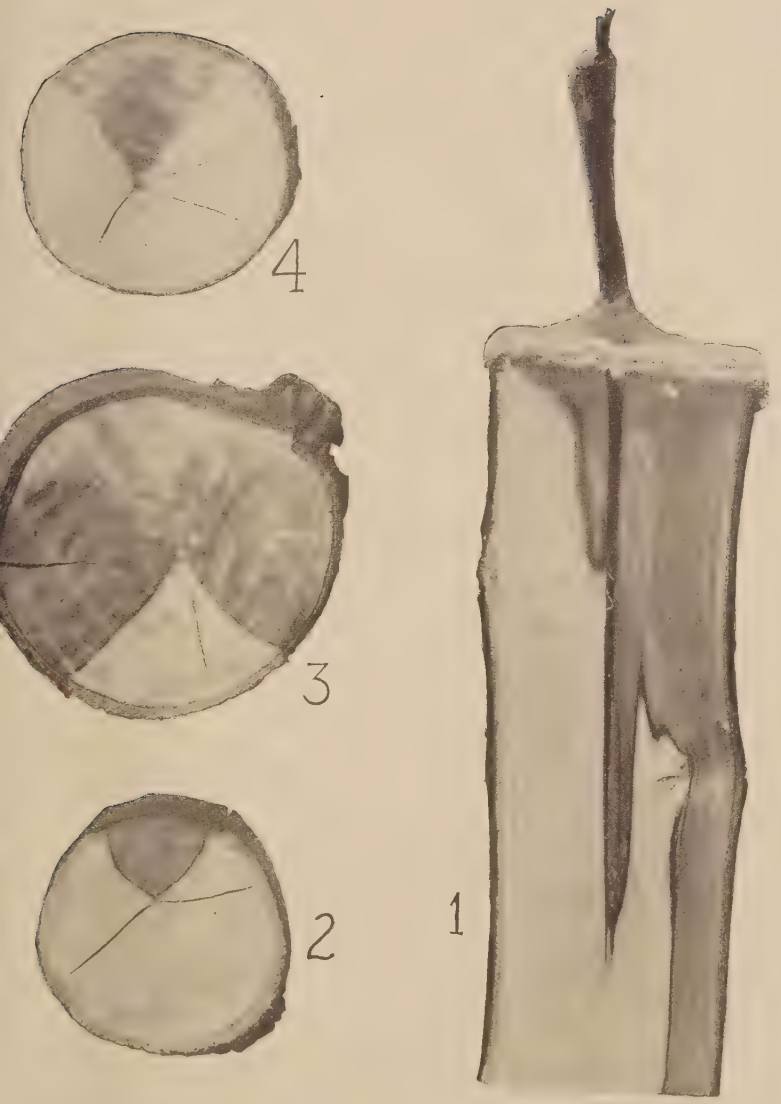

PLATE XIV.—PEAR STOCKS AFFECTED WITH CANKER.

1. Longitudinal section of specimen shown in Plate XIII. 2. Cross-section of same two inches from lower end of canker. 3 and 4. Cross-sections of other stocks. (All figures natural size.)

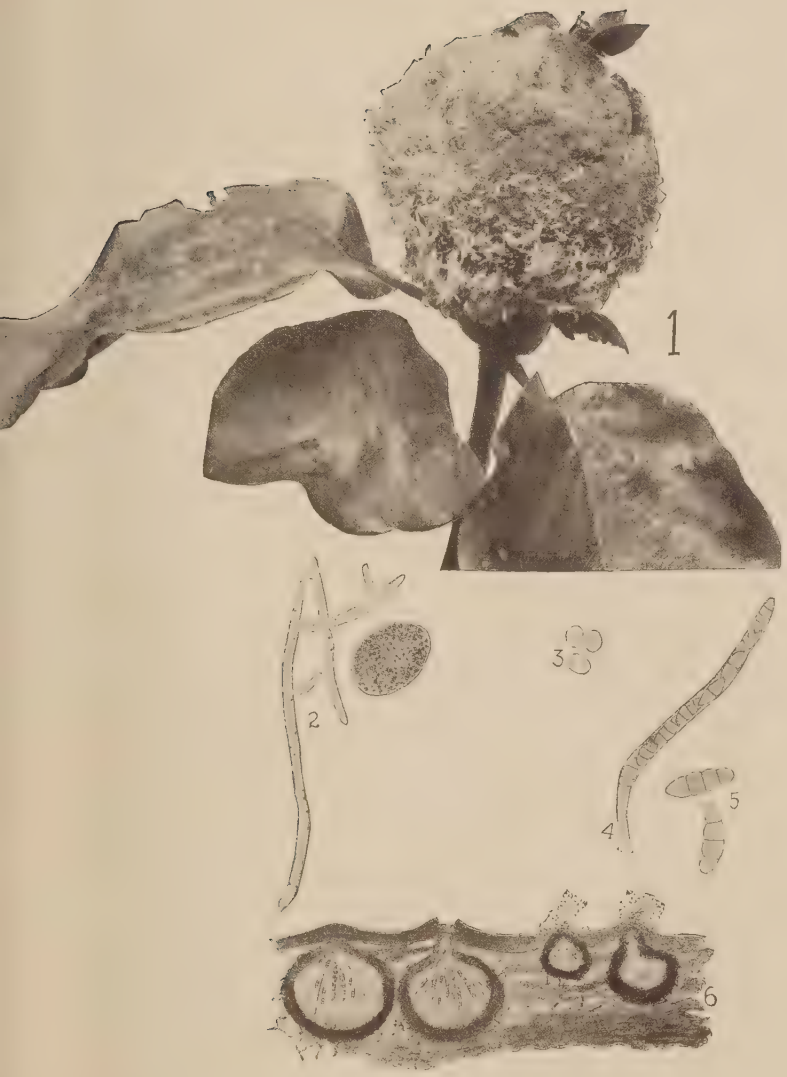

PLATE XV.—QUINCE RUST (1) AND RASPBERRY FUNGI.

2. Conidiophore and spore of *Botrytis patula* × 350.
3. Spores of *Coniothyrium fuckelii* × 850.
4. An ascus of *Leptosphæria coniothyrium* × 350.
5. Spores of *Leptosphæria coniothyrium* × 660.
6. Cross-section of diseased raspberry bark showing two perithecia of *Leptosphæria coniothyrium* (on the left) and two pycnidia of *Coniothyrium fuckelii* (on the right) × 65.

PLATE XVI.— A FASCIATED ROSE CANE.

PLATE XVII.— TOMATO STEM NEARLY SEVERED BY TRANSVERSE CRACK, TWELVE INCHES BELOW THE TIP.
(One-half natural size.)

PLATE XVIII.— RADISHES ARTIFICIALLY INOCULATED WITH RHIZOCTONIA FROM CARNATION, *Actinidia polygama*. *Lactuca scariola*, *Impatiens* SP., CABBAGE AND LETTUCE. LOWER FIGURE AT LEFT, CHECK.

under surface, the general appearance of the foliage was but little out of the normal.

The galls are smooth, saucer-shaped bodies attached to the leaf by a short, slender foot-stalk.[10] It appears that they are at first flat and become saucer-shaped as they grow older. They are about two millimeters high and have a diameter of two to five millimeters. The margin of the saucer turns outward and a small conical elevation (marking the location of the larva) appears at the center. The color of the galls is white owing to a heavy bloom composed of short, rod-shaped bodies. When this bloom is removed some of the galls appear pink and others greenish. In general appearance the galls bear a striking resemblance to the apothecia of a Discomycetous fungus, but a microscopic examination quickly dispels the idea that they are fungus bodies. They have a cellular structure, a vascular system and contain an abundance of starch. In our observations only occasional larvæ were found and these were very small and immature. The galls are irregularly distributed on the under surface of the leaf exclusively. Sometimes several galls occur so close together that they crowd one another and become distorted. The leaf shown in Plate XI bore 154 galls, which is not an unusually large number. On the upper surface the affected portions of the leaf are somewhat yellowish and uneven owing to the presence of small pimples which mark the location of the galls.

Specimens of the galls were submitted to the late Prof. M. V. Slingerland of Cornell University, who reported concerning them as follows: "It is the work of *Cynips poculum* O. S. The galls are known as 'oak spangles.' See Fitch's Fifth Report on Insects of New York, Section 320; also, Monograph of Diptera of North America, Part I, page 201. In Beutenmüller's catalogue of gall-producing insects found within fifty miles of New York City (Bul. Am. Mus. Nat. Hist. 4: 245–278) the insect is called *Cecidomyia poculum* and the statement made that it has not been raised from the galls in this country. A student here

[10] Host Herbarium Specimen No. 49.

[Miss Susan F. Howe] wrote her thesis on these oak galls and bred the flies, and they are a Cynips instead of a Cecidomyiid."

We are informed that this thesis has not been published.

OATS.

Avena sativa.

Blade blight, ?*Pseudomonas avenæ* Manns and *Bacillus avenæ* Manns. In 1906, 1907 and 1909 oats throughout New York State were quite generally affected by blade blight, which according to Manns, is caused by the associative action of the two species of bacteria named above.[11] The disease appears during June. The tips of the leaves become reddish or yellowish then turn brown and slowly wither and die. The affected plants are not killed outright, but their growth is checked.

June 2, 1909, a somewhat similar disease was prevalent in all oatfields in the vicinity of Riverhead, Long Island. The plants were then 8 to 12 inches high and the discoloration of the leaves extended backward from the tip for a distance of 3 to 5 inches. Many of the affected leaves showed irregular, water-soaked areas very suggestive of bacterial action. At this time there were no signs of such disease in central and western New York, but by the latter part of June the reddening of oats had become general.

Except in the case mentioned above we have never seen anything which would lead us to believe that this blade blight is a bacterial or fungus disease. On the contrary, the uniform distribution of the disease indicates that it is not contagious. The symptoms are rather those of defective nutrition caused by unfavorable weather conditions. The writer is inclined to doubt the accuracy of Manns' conclusions even though they seem to be supported by the results of his inoculation experiments. Possibly two distinct diseases have been confused.

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[11] Manns (78).

PEACH.

Prunus persica.

Premature dropping of leaves. The observations reported under this head were published eleven years ago in the Proceedings of the Eastern New York Horticultural Society. On account of the very limited circulation of these Proceedings it seems desirable to reproduce the article here. The writer has seen nothing of the kind since and has nothing to add concerning the cause of the strange phenomenon. The account is as follows:[12]

"On June 1, [1900] Mr. J. A. Hepworth of Marlboro, called our attention to the fact that peach trees in that locality were dropping their leaves very freely. We visited several peach orchards and in all of them the leaves were dropping more or less. In some cases the ground under the trees was green with the fallen leaves. When the trees were jarred, clouds of leaves would fall. Not infrequently 10 to 15 per ct. of the leaves fell; and we saw a few trees which had probably lost as much as 20 per ct. of their leaves. Mr. Hepworth first noticed the trouble May 30.

"The fallen leaves were green and apparently normal except that on the margins there invariably occurred one or more dead brown spots. These spots were semi-circular, one-fourth to one-half inch across, generally situated on the margin from one-half to two-thirds of the distance toward the outer end of the leaf, rarely at the tip and never on the interior. Frequently, there were two spots situated on opposite margins of the leaf, sometimes only one and again 3 to 5 spots.[13] In color, the spots were at first reddish brown or bronze, but later light brown and dry. Often the spots showed a tendency to separate from the green tissue, but it was rare that they actually dropped out. The spots were to be found on leaves still on the tree and such leaves would fall with the slightest jar. There was no discoloration at the point where the petiole separated from the twig.

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12 Stewart (141).

13 Host Herbarium Specimen No. 50.

"The drop was general on all varieties, on soil cultivated and uncultivated, fertilized and unfertilized, drained and undrained, on thrifty and unthrifty trees, and in exposed and protected situations. In one case we saw a young orchard not yet in bearing standing close beside an old orchard. No leaves were dropping from the young trees, while in the old orchard fully 15 per ct. of the leaves were on the ground.

"We do not know how widespread the dropping of peach leaves may have been. It was quite general in the vicinity of Marlboro, but did not occur farther up the Hudson at West Athens or Catskill, or anywhere in western New York so far as we can learn. Mr. John Gould, Aurora Station, O., informs us that a similar peach leaf-drop occurred in some parts of Ohio during the past season. It is very unusual for peaches to drop their leaves in this manner.

"There were no indications of the presence of any fungus on the spots. Certainly, the trouble was not of fungous origin. It was due to purely physiological causes; and we believe it was brought about by weather conditions; exactly what these conditions were we do not know.

"In seeking to account for the dropping of the leaves something besides the spots must be considered; because the spots were too few and too small to have caused (by themselves) the leaves to fall. And yet, if we could determine the cause of the spots it would probably be easy to account for the falling of the leaves, because the two phenomena evidently owe their origin to the same cause."

Powdery mildew, *Sphærotheca pannosa* (Wallr.) Lév. ? The Station orchard contains 350 varieties of peaches, 50 of apricots and 33 of nectarines, planted from one to four years. The season of 1910 being a favorable one for peach powdery mildew it was thought a good opportunity to determine the relative susceptibility of the different varieties. Accordingly, on August 31 a tour of the orchard was made and affected varieties noted. Mildew was

found on only eight varieties of peaches and two varieties of nectarines[14] The peaches affected were: Bailey, Conkling (moderately), Tillotson, Simmons No. 1,[15] Wright, Morrell, Thomas Rivers and Illinois Peach. The affected nectarines were Early Newington and Hunt's Tawney.

On June 24, 1910, a fruit grower from Holley brought to the Station leaves, twigs and fruit of peach showing an abundant growth of powdery mildew. He said that the tree from which the specimens came was a seedling. This is exceptionally early for so severe an attack.

The writer has never seen perithecia of the peach powdery mildew.

PEAR.

Pyrus communis.

Crimson foliage. During the past few years a certain Kieffer pear orchard at Geneva has behaved in an interesting manner. The orchard contains 60 trees in four rows of 15 trees each. The rows run north and south. The north end of the orchard is on a hillside while in the southern portion the land slopes just enough to give good surface drainage. The trees on the hillside are much larger, thriftier and more productive than those in the lower part of the orchard. The unthriftiness of the trees on the low land is probably due, chiefly, to an excess of water in the soil.

The interesting feature of the orchard is the coloration of the foliage in autumn. During October the leaves on most of the trees on the low land become brilliantly colored (a shade of red) while those on the hillside show but little if any such color. In 1906 and 1907 the contrast was particularly striking. By November 4, 1906, the trees on the low land (with one exception) had dropped most of their leaves, which had been brilliantly colored for about a month; while the 24 trees on the hillside held practi-

[14] As some of these varieties have not fruited it is not known that they are true to name.

[15] This is a temporary name given a seedling.

cally all of their leaves and they were still green. In 1907 the trees on the low land (with two exceptions) were moderately colored from about October 1 to October 20. Then there came a hard frost and immediately afterward the foliage became very brilliantly colored. A few days later there was another hard frost which caused the colored leaves to blacken and fall. By November 1 the trees were bare of leaves. But the trees on the hillside were still in full foliage as late as November 10. About November 1 they began to change their color from green to a shade of yellow. On November 10 yellow was the dominant color, but there was a little red mixed with it.

In 1906 one tree on the low land behaved like the trees on the hillside. This tree was considerably larger and thriftier than its neighbors. In 1907 *two* trees kept their leaves green and held them late like the trees on the hillside. One of these was the exception of 1906, but the other was a small unthrifty tree standing next to it.

At times this orchard has been used for a chicken run and the chicken house being at the north end it is likely that the trees in that part of the orchard have received more nitrogen which probably accounts, in part, for their greener foliage and greater thriftiness.

However this may be, it is plain that crimson foliage on pear trees is a sign of unthriftiness. The specific causes of the unthriftiness may be various — poor underdrainage, insufficient plant food, a diseased condition of the trunk or roots, winter injury, drought injury, etc.

Œdema. Early in March, 1910, one of the large nursery companies of Rochester called our attention to a peculiar trouble affecting pear trees in their store house. On March 14 the writer visited the store house for the purpose of investigating the trouble and found the trees affected as follows: On the trunk around the bases of the branches, also around scars where branches had been cut off the previous fall before the trees were placed in storage

and even at the "union" (the point where cion and stock unite) the bark had loosened and cracked exposing loose-celled greenish-white œdematous tissue. In the handling of the trees incident to packing this loosened bark often rubbed off and upon exposure to dry air the thin-walled cells of the white tissue quickly collapsed and turned black. Accordingly, when unpacked by the planter, the trees presented a bad appearance. The store house contained large quantities of pear trees of many varieties all of which were more or less affected. The Sheldon was more affected, perhaps, than any other variety, but some of the dwarf varieties were nearly as bad. Trees of apple, peach, plum and cherry stored in the same house under parallel conditions were unaffected.

A member of the nursery company stated that they had been storing pear trees for 15 years past and never before had any such trouble. Out of 25 leading New York nurserymen with whom we have corresponded on this subject only three have ever seen the trouble. One from Niagara County writes as follows: "Some years ago we had considerable stock with similar injury. At that time we stored in a new cellar which was rather moist and warm and we always thought it was caused by excessive moisture and heat. Cions very often take on the same condition when held late especially if moist and warm." Another nurseryman, from Dansville, writes as follows: "Since 1876 I have observed that the rapid growing pears have shown the condition mentioned. Except in isolated individuals no harm has appeared. In bad cases, showing in the autumn over a surface of two inches square, the tree if left in the nursery row will show winter injury. This condition also obtains in rapidly grown apple trees like King and Baldwin." The third is a Fredonia nurseryman who has observed it, but never lost any trees on account of it. On May 3, 1897, this gentleman sent us a specimen accompanied by the following letter: "By this mail I send you a section of a Duchess d'Angoulême standard pear tree on which the bark split open much in the same way as pop-corn splits when roasted.

They did this during the winter in the nursery cellar. I had the same thing occur once before on dwarf trees, but only on the Duchess; no other variety was so affected." This is the only instance of pear œdema coming under our observation prior to the Rochester case.

The loss on the pear trees being considerable the nursery company wished to learn the cause of the trouble in order that a recurrence of it might be avoided. A very brief examination sufficed to convince us that it was not caused by an organism of any kind — fungus, bacterium or insect. It was plainly a physiological disorder known as œdema. In growing plants, œdema is believed to be due to an excess of water in the tissues which causes the cells to become abnormally distended. Such accumulation of water is favored by wet soil and high temperature coupled with high humidity and insufficient light.[16]

Naturally, the cause of such a severe case of an unusual trouble is to be sought in some unusual conditions surrounding the trees. The most notable and unusual feature of the season of 1909 was the severe drought in the fall; but œdema would not be favored by drought. Moreover, it does not seem that the weather can have had anything to do with it because other nurserymen growing pear trees in the same locality had no such trouble. So far as can be learned the trees were not subjected to any unusual methods of culture and the matter of soil seems to be eliminated by the fact that the trees were grown in three different localities. Likewise, there seems to have been nothing unusual in the management of the storehouse. A daily record was kept of the maximum and minimum temperature and humidity of the air in the store house. According to this record, the temperature and humidity of the store house during the winter of 1909–10 were practically the same as in previous years. This is shown in the accompanying table:

[16] See Atkinson (7 and 8) and Sorauer (134, p. 337).

TABLE I. TEMPERATURE AND HUMIDITY IN NURSERY STORE HOUSE.

MONTH AND YEAR	Humidity			Temperature					
				Minimum			Maximum		
	Lowest	Highest	Average	Lowest	Highest	Average	Lowest	Highest	Average
	Per ct.	*Per ct.*	*Per ct.*	*Deg. F*	*Deg. F*	*Deg. F*	*Deg. F*	*Deg. F*	*Deg. F*
December, 1907...	80	82	81.8	34	43	37.1	35	45	39.1
1908...	79	82	80.9	33	48	35.1	35	50	37.6
1909...	77	79	78.7	33	38	35.7	35	40	37.5
January, 1908...	80	82	81.6	33	37	34.5	34	38	35.5
1909...	78	82	80.1	33	40	34.7	34	44	36.9
1910...	77	81	79.2	33	37	34.7	35	38	36.5
February, 1908...	82	82	82.0	33	38	34.3	34	39	35.3
1909...	78	80	79.2	33	36	34.1	34	39	35.2
1910...	80	81	80.1	33	35	34.2	34	37	35.5

The store house is a large one, built entirely above ground and well lighted by means of skylights. The trees are piled in long double ricks with the tops inside and the roots exposed. These double ricks are about sixteen feet high and separated by passages six feet wide. When the humidity falls below the desired point the roots of the trees are sprayed with water. When the temperature gets too high the ventilators are opened.

In order to determine what the after effects of the œdema might be, twelve badly affected trees were planted on the Station grounds and kept under observation until the following winter. This lot of trees contained two Clapp's Favorite, two dwarf Bartlett, two dwarf Wilder, two dwarf Louise Bonne de Jersey and four Sheldon. The Louise Bonne de Jersey and Sheldon trees were three years old, the others two years old. The four Sheldon trees were affected only around the bases of the branches, but on all the others the œdema occurred also at the "union."

One dwarf Wilder and one Sheldon tree started slowly, but all of the others apparently made a normal growth. At an exami-

nation made in October it was found that only a few of the affected branches had died. In most cases the wounds made by the œdema had healed leaving merely a ring of rough bark around the base of the branch. This experiment shows that the affected trees were but slightly, if at all, injured for planting.

While this pear trouble is clearly a case of œdema we are unable to explain how it was brought about or how its recurrence may be prevented.

Rust, *Gymnosporangium globosum* Farl.[17] Mr. F. A. Sirrine, Riverhead, Long Island, has a Kieffer[18] pear orchard of 150 trees set in the spring of 1903. On three sides it is bordered by thickets of red cedar. Each year since the trees were planted they have been more or less affected with rust. Prior to 1910 only the leaves were affected; but in the season of 1910 both fruit and leaves were severely attacked. On every tree almost every leaf showed numerous rust spots and many fruits were affected. Yet the damage was not great. Mr. Sirrine reports that the trees held most of their foliage until late in the fall, but some of the worst-affected leaves fell during August. Affected fruits were worthless, but as the fruit needed thinning they were not missed.

The following observations were made on June 15: Viewed from the upper surface the leaf spots were dark brown or nearly black with a conspicuous red border.[19] On the under surface they were of the same dark color, but the red border was lacking. Only the larger spots showed æcia which were commonly on the under surface though occasionally on the upper surface and, sometimes, also on the petioles.[20] Frequently, the rust spots were arranged in two irregular rows — one on each side of the midrib — as if infection had occurred before the leaves were unfolded. The affected fruits, although still on the trees, were usually less than

[17] Identified by F. D. Kern.

[18] The Kieffer pear is a hybrid between *Pyrus communis* and *P. sinensis* (Bailey, Cyc. Am. Hort. p. 1471).

[19] On June 1, 1904, when the rust spots of that season were just beginning to appear the great majority were bright yellow and of pinhead size. Only a few (the larger ones) had reddish borders.

[20] Host Herbarium Specimen No. 51.

half normal size. Frequently, they were no larger than peas while normal fruits at this time were an inch long and three-fourths of an inch in diameter. (Plate XII.) They were almost invariably misshapen. While the point of attack might be on any part of the fruit it was commonly near the base where there was a circular, flattened, black area devoid of æcia. However, there were to be found, here and there, affected fruits showing an abundance of well developed æcia.[21]

Proximity to the cedars appeared to make little difference in the amount of the rust. Trees 15 or 20 rods distant were quite as much affected as those standing within 20 feet of the cedars.

Mr. Sirrine informs us that this orchard was sprayed with bordeaux mixture while the trees were in full bloom. Had the spraying been done just after blooming it might have been more effective since the infection, at least on the fruit, must have occurred after blooming.

In the affected Kieffer orchard there were five trees of Worden and a row of Duchess on dwarf stock. No trace of rust could be found on either the fruit or leaves of the Duchess. The foliage of Worden, also, was free from rust, but many fruits of this variety were affected and a few showed well developed æcia.

Mr. Sirrine has another pear orchard surrounded on all sides by the same kind of red cedar thickets. This orchard was planted in the spring of 1909. Most of the trees are of the varieties Bartlett and Bosc. Not a trace of rust could be found here.

This rust of pears is a rare disease in New York. Besides the Long Island orchard above mentioned we have observed it in only two other localities, viz., at Milton and Athens where the foliage of Kieffer pears was sparingly affected in 1901. Thaxter[22] reported the same rust on the leaves of Kieffer pears in Connecticut twenty years ago.

Failure of grafts. ? *Sphæropsis malorum* Berk. During the past few years a pear grower of Kendaia who has done considerable grafting in his orchard has had trouble with a disease which causes

[21] Museum Specimen No. 137 and Host Herbarium Specimen No. 52.
[22] Thaxter (154, p. 98).

the failure of the grafts by killing the end of the stock in which the cions are set.[23] Of the grafts made in the spring of 1908 about one-half failed from this cause. The trees used as stocks have been of several varieties, chiefly Sheldon, Bartlett, Anjou and Kieffer, and the trouble has appeared on them all. In the spring of 1909 the cions used were mostly of the variety Seckel. Many of the cions did not even start to grow. Others made a fair growth and were still alive in the spring of 1910, but were worthless because the end of the stock in which they stood was so badly cankered near the top that there never could be a good union between the cion and the stock. In April affected stocks appear as follows: Extending backward from the wax-covered end of the stock a distance of one to twelve inches the bark is dead and the wood beneath discolored. In some cases the whole upper part of the stock is affected; in others, a strip of dead bark extends down one side of the stock while on the other side the bark is normal. (Plate XIII.) The dead bark clings tightly to the wood. The affected area is bounded by a narrow crack which separates it sharply from the living bark adjacent. Almost invariably the brown discoloration of the wood extends clear to the pith, so that a stock having a narrow diseased strip on one side, shows, in cross-section, a V-shaped area which is frequently bounded by a narrow black line. (Plate XIV, figs. 2, 3 and 4.) When the diseased area completely surrounds the upper end of the stock the cions do not start. When there is a strip of live bark on one side of the stock the cion on that side grows. No instance was observed in which the cion had started to grow and afterward died. This indicates that the disease started early and ran its course quickly. However, many of the cankers show evidence of two periods of activity. Whether these two periods occurred in the same season or in successive seasons was not determined.

Apparently, infection occurs at the time of grafting. Certainly, the disease does not enter through the cion but through the wound made in grafting. The lesions resemble those caused by the fire

[23] Museum Specimen No. 112.

blight organism, *Bacillus amylovorus*, but it seems improbable that it is a case of fire blight. There has been very little fire blight in the orchard for several years. Besides, it is somewhat difficult to infect mature wood with *Bacillus amylovorus*.[24] Suspicion points rather to *Sphæropsis malorum* as the cause. Pycnidia of this fungus were plentiful on the dead bark and sometimes, also, on the dead cions. Sphæropsis cankers on pear branches are of frequent occurrence in nature and Paddock's experiments demonstrated that such cankers may be produced by artificial inoculation.[25] Opposed to this theory is the fact that *S. malorum* is a very common fungus, whereas the graft trouble seems to be rare.

Whatever the causal organism, disinfection of the cut end of the stock before the covering of wax is applied should prevent the trouble. Probably the best method of disinfection would be by the use of a sponge saturated with a 1–1000 solution of corrosive sublimate.

PELARGONIUM, IVY-LEAVED.

Pelargonium peltatum.

Œdema. On December 10, 1909, there came to our attention a case of œdema on pelargonium leaves in a greenhouse at Batavia. The plants were rooted cuttings just commencing vigorous growth. They were still in sand in the cutting bench. The air inside the greenhouse was kept rather warm and very moist. A considerable number of the leaves showed œdema, but the trouble was not sufficiently abundant to cause material damage. The disease manifested itself in the form of pimple-like elevations of two kinds: (1) Smooth, shiny ones having a water-soaked appearance; (2) irregular, gray, rough-topped ones. Both kinds of pimples occurred on both surfaces of the leaves, but were much more numerous on the under surface. Halsted[26] has noted the occurrence of this disease in New Jersey. According to Ward it may be expected to appear at any period of growth if the plants are over watered under high temperature.[27]

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[24] Arthur (4, p. 273).
[25] Paddock, (86).
[26] Halsted (51, p. 432).
[27] Ward (160).

PHLOX.

Phlox sp.

Powdery mildew, *Erysiphe cichoraccarum* DC. This is a common and often destructive disease of cultivated phlox. During the past ten years the Station has received numerous complaints of its ravages. It was observed to be very destructive at Queens in August, 1902, and at Riverhead in October, 1909.[28] The leaves and stems become thickly covered with a dirty-white mildew. In severe attacks the lower leaves fall prematurely. Perithecia are formed in great abundance on both leaf surfaces and also on the stems.

Leaf-spot, *Cercospora phlogina* Peck in MS. Specimens of a Cercospora on cultivated Phlox collected by the writer at Floral Park, June 28, 1900, were referred recently to Prof. C. H. Peck, State Botanist, who writes as follows concerning them: "I have examined the specimens of Cercospora on Phlox leaves, and think, like you, that it disagrees too much from the description of *C. omphacodes* to be lumped in with it, though its spores come near an agreement. It may be a variety, but I prefer to consider it a distinct species. I do not find any other Cercospora than *C. omphacodes* credited to Phlox so call your specimen *Cercospora phlogina* n. sp."

The fungus forms circular brown spots, usually 5 to 10 mm. in diameter, and conspicuous on both sides of the leaf. On the under surface the spots are of fairly uniform brown color all over, but on the upper surface they have a wide, dark brown border surrounding a lighter colored central portion.[29]

The brown spots were very numerous indicating that under favorable conditions the disease might become of economic importance.

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[28] Host Herbarium Specimens No. 53 and 54.
[29] Host Herbarium Specimen No. 55.

PLUM.

Prunus spp.

Fungi on black knot, *Tricothecium roseum* (Bull.) Link and *Sporotrichum parasiticum* Pk. The black knot excrescences (caused by *Plowrightia morbosa*) on plum branches are frequently overgrown by *Tricothecium roseum* which forms a thin coating of pale salmon color. The spores of the fungus are nearly hyaline, pear-shaped and two celled. In a large orchard of German prunes near Geneva most of the trees were ruined by a severe attack of black knot. In the autumn of 1909 a majority of the knots in this orchard were quite thickly covered with *Tricothecium roseum*.[30] The fungus is considered to be only a saprophyte.

In October, 1909, the black knots on some neglected plum trees (*Prunus domestica*) at Seneca Castle were found to be covered with a whitish growth of *Sporotrichum parasiticum* Pk.[31] The shape of the hyaline, non-septate spores is described as elliptical,[32] but in these specimens many of the spores were distinctly fusoid.[33] Peck states that when the Sporotrichum occurs on young knots it apparently prevents the free formation of the Plowrightia perithecia.

Twig blight and canker, *Sclerotinia fructigena* (Pers.) Schrt. It does not appear to be generally known to fruit growers that plum twigs are frequently killed by the fruit-rot fungus, *Sclerotinia fructigena*. Severe attacks of fruit rot are usually accompanied by the dying of some of the smaller branches. Sometimes such trouble becomes conspicuous and attracts attention. A case of this kind occurred in orchards of Japanese plums (*Prunus triflora*) at Milton in 1901. On some trees fully one-third of the foliage was dead and brown. Upright-growing varieties, like Red June and Wickson, were most affected. In most cases the dead twigs were covered with the Monilia stage of the fruit-rot fungus

[30] Museum Specimen No. 138.
[31] Identified by C. H. Peck.
[32] Peck (95, p. 82).
[33] Host Herbarium Specimen No. 56 and Museum Specimen No. 139.

and often there was an exudation of gum at the boundary between the living and dead wood.

A particularly interesting case of Sclerotinia twig blight occurred in a Geneva nursery in 1910. The affected trees were of the variety Compass which is said to be a hybrid produced from seed of the sand cherry (*Prunus besseyi*) fertilized by Miner plum (*Prunus hortulana*).[34] It is considered an exceptionally hardy variety. The trouble occurred in a block of about 3000 trees budded in the season of 1908. On May 24, 1910, almost every tree was more or less affected. On many trees the whole top was conspicuously browned. At this time the new shoots were two to four inches long. Many of them were dead and brown. Most of the trouble occurred in the upper part of the tree — the uppermost 12 to 15 inches — but here and there dead shoots were found lower down. Healthy and dead shoots were intermingled. Some of the shoots were just wilting; others were brown and dry. Most of the dead shoots were covered with a luxuriant growth of Monilia at the base and frequently there was an exudation of gum at this point. The trees had bloomed freely and the blossoms had been blasted by Monilia. The shriveled, Monilia-covered flower clusters were still to be seen in the axils of the twigs. It was plain that the twigs had been attacked at the base. There were many which were dead at the base while only wilted at the top. The fungus had gone in by way of the blossoms, not through the tip of the shoot. On both sides of the affected block of trees were several thousand plum trees of various Japanese and *Prunus domestica* varieties all entirely free from the disease; but none of these had bloomed.

In another part of the same nursery a block of 10,000 plum trees of the same age and variety were similarly affected. Here, an adjacent block of the variety Wild Goose (*Prunus munsoniana*) showed a little of the trouble and it was found that every dead twig had a cluster of dead blossoms in the axil. Also, on a few rows of double flowering almond (*Prunus japonica*), nearby, the shoots were killed back 12 or 14 inches by Monilia.

[34] Little (72).

Sometime during June the diseased tops of the Compass trees were cut away. The result was that by the middle of September the trees appeared healthy and thrifty, but upon closer examination it was found that a majority of the trees had cankers on the trunk. These cankers were one to two inches long. Frequently, the wood was laid bare and there was a copious exudation of gum. A small dead twig at the center of each canker plainly indicated that it had its origin in the Monilia attack.

POPPY MALLOW.

Callirhoë involucrata.

Rust, *Æcidium tuberculatum* E. & K. Specimens of this were collected by F. H. Blodgett on June 16, 1899, at Floral Park where it was abundant and destructive. Plants severely attacked produce dense clusters of short, upright shoots, while on healthy plants the branches are procumbent.[35] Only the æcial form of this fungus is known. Carleton has suggested that it is perennial within the tissues of its host and so does not require an alternate form for its perpetuation.[36]

POTATO.

Solanum tuberosum.

Rhizoctonia. Rolfs holds that a species of Rhizoctonia, which he has shown to be connected with *Corticium vagum* B. & C. var. *solani* Burt, is responsible for extensive potato failures in Colorado,[37] and Selby ascribes a destructive "rosette" disease of potatoes in Ohio to the same fungus.[38] What appears to be the same species of Rhizoctonia occurs very abundantly on the tubers and underground stems of potatoes in New York,[39] yet we have seen only a few instances in which the plants seemed to be materially injured by it. We consider Rhizoctonia a comparatively unim-

[35] Host Herbarium Specimen No. 57.
[36] Carleton (17; 18, p. 27).
[37] Rolfs (109 and 110).
[38] Selby (125 and 126).
[39] Duggar and Stewart (29, pp. 17–22).

portant disease of potatoes in New York except, possibly, on Long Island.

In 1904 we planted two rows with Rhizoctonia-infested tubers. Previous to planting, the tubers used in one of the rows were disinfected by soaking them two hours in a solution containing one pint of formalin in thirty gallons of water. The resultant plants on both rows were healthy. There were no indications of rosette and none of the plants died prematurely. The two rows gave the same yield, viz., 377 pounds or at the rate of 314 bushels per acre. Certainly, the Rhizoctonia was not very harmful in this case. However, it should be stated that the crop, even on the row planted with untreated seed, was but little infested with Rhizoctonia. The soil conditions may have been unfavorable to the fungus.

On June 17, 1910, the writer saw, for the first time, fresh specimens of *Corticium vagum* var. *solani* on living potato stems. It was at Orient, Long Island. Many potato fields in eastern Long Island were in poor condition at this time. There were many undersized, sickly-looking plants with small, curled leaves which were sometimes green and sometimes yellowish. While endeavoring to determine the cause of this trouble it was observed that the stems of some of the affected plants were coated with a bluish-gray, mealy fungus which extended from the surface of the soil to a hight of one to three inches, sometimes enveloping also the lower leaves. Upon microscopic examination the fungus proved to be *Corticium vagum* var. *solani*. The following day the same fungus was found on many plants in several potato fields at Riverhead. In the great majority of cases the plants showing Corticium were sickly ones, but occasionally it occurred on large, thrifty plants. While the Corticium seemed to prefer stunted plants, it was by no means clear that the fungus was responsible for their unhealthy condition. On many of the Corticium-infested plants it was impossible to find any lesions on the stem, either above or below ground; the roots appeared normal and the seed piece was still sound. The portion of the stem covered by the Corticium was in no way injured by it. The fungus was entirely superficial and could be readily washed or rubbed off. The plants on which it was found were 6

to 12 inches high. Its appearance had been preceded by a period of wet, foggy weather.

Some mycologists regard *Rhizoctonia violacea* Tul. synonymous with *R. solani* Kühn.[40] On this point the writer does not care to express an opinion. The purpose of this note is to show that the Rhizoctonia of potatoes in Colorado and New York is not *R. violacea*. In the first place, there is a marked difference in color — the potato Rhizoctonia is brown while *R. violacea* on alfalfa roots is readily identified by its violet color. Secondly, the potato Rhizoctonia is abundant in the potato fields of New York and Colorado while, so far as we know, *R. violacea* has never been collected on alfalfa roots in either of these states. Experience has shown that, in New York, at least, Rhizoctonia-infested potato fields may be seeded to alfalfa with safety. The writer is confident that the potato Rhizoctonia of New York is identical with the potato Rhizoctonia of Colorado, but it is entirely different from *R. violacea* on alfalfa.

QUINCE.

Cydonia vulgaris.

Rust, *Gymnosporangium clavipes* C. & P.[41] During the summer of 1910 quinces throughout western New York were quite generally attacked by rust. It was observed, also, at Milton in the Hudson valley. The disease was more common than at any previous time since 1897. Both twigs and fruit were affected. On twigs the point of attack was commonly at the base of new shoots. Affected fruits were very conspicuous during July and August. They were covered, either wholly or in part, by masses of orange-yellow æcia, the long peridia of which often gave the fruit a woolly appearance. (Plate XV, fig. 1.)[42] Some fruits were attacked at the stem end, others at the calyx end, and usually the affected fruits were much distorted and entirely worthless. In many cases no red cedar trees were to be found anywhere in the vicinity of the affected quince orchards.

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40 Saccardo (115, **14**:1175); Güssow (47).
41 Identified by F. D. Kern.
42 Host Herbarium Specimens Nos. 58 and 59.

RADISH.

Raphanus sativus.

Damping off, *Rhizoctonia* sp.[43] A number of radish beds in an Irondequoit greenhouse inspected during January, 1910, were observed to contain circular spots from a few inches to a foot or more in diameter in which the plants were dying. A number of the diseased plants, at various stages of growth, were collected and brought to the Station. A microscopic examination showed that all were affected with the fungus, Rhizoctonia. Observation indicates that infection takes place first at the level of the soil causing the leaves to have a wilted, drooping appearance. From this point the disease spreads into the leaves and root of the plant, soon causing its death. On mature radishes decayed spots of irregular shape are produced and at an advanced stage the diseased portions of the plant are covered with a white felted mycelium.

This radish disease has been described, previously, in Bulletin 186 of this Station.[44] It has also been illustrated by Duggar.[45] The causal fungus produces spores but rarely, if at all, and therefore can be transferred from place to place only by diseased plants or infected soil. The experience of growers has shown conclusively that it can be effectively controlled by steam sterilization of the soil.

Some cross-inoculation experiments made by Mr. Stewart in 1902 indicate that radishes are susceptible to attack by Rhizoctonia occurring on several species of host plants. Radishes were artificially inoculated with pure cultures of Rhizoctonia from carnation, *Actinidia polygama*, *Lactuca scariola*, *Impatiens* sp., cabbage and lettuce. Pronounced cases of rot resulted from all of the inoculations, while check plants remained perfectly sound to the end of the experiment. (Plate XVIII.)

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[43] By S. M. McMurran.
[44] Duggar and Stewart (29, p. 22).
[45] Duggar (28, p. 446).

RASPBERRY.

Rubus spp.

Cane blight, *Leptosphæria coniothyrium* (Fckl.) Sacc. In an earlier publication of this Station the writer described a destructive disease of raspberry canes caused by a fungus which was doubtfully referred to *Coniothyrium fuckelii* Sacc.[46] Subsequently, it was observed that, in spring, a pyrenomycetous fungus, *Leptosphæria coniothyrium* (Fckl.) Sacc., is frequently associated with the Coniothyrium on raspberry canes killed by it the preceding summer. (Plate XV, fig. 6.)[47] The same thing has been observed previously by others and most writers have followed Fuckel and Saccardo[48] in the assumption that these fungi are two forms of one species. However, it appears that the only evidence of such relationship is the intimate association of the two forms.

In the spring of 1903 the writer set out to learn the truth about this matter. Dilution cultures of Leptosphæria spores were made in potato agar in petri dishes. Individual spores were located and kept under observation during germination. As soon as they had made sufficient growth they were transferred to sterilized plugs of sugar beet. Five cultures of undoubted purity, from five separate Leptosphæria spores, were thus obtained. In all of these cultures there appeared an abundance of Coniothyrium spores indistinguishable from those obtained directly from raspberry canes. This is positive proof that the raspberry Coniothyrium is genetically related to *Leptosphæria coniothyrium* as has been suspected. It may be added that no indication of an ascogenous form appeared in any of the cultures.

Leptosphæria coniothyrium forms black patches on dead canes of both black and red raspberries. At Geneva, the perithecia ripen in April. Normally, the spores have three very distinct septa, but uniseptate spores are not uncommon. (Plate XV, fig. 4.)

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[46] Stewart and Eustace (151). Host Herbarium Specimen No. 60.
[47] Host Herbarium Specimen No. 61.
[48] Fuckel (44, p. 115); Saccardo (115, 2:29).

In order to learn how long *Leptosphæria coniothyrium* may live on dead raspberry canes lying on the ground the following experiment was made: In April, 1903, ten pieces of red raspberry canes, all well covered with Coniothyrium and some of them showing also Leptosphæria, were placed on the surface of the ground and protected by a slatted cage. Four years later (April, 1907) the canes were carefully examined. They were still in a fair state of preservation. Not a single spore of Coniothyrium could be found on any of them; but one cane showed some Leptosphæria perithecia. One perithecium, in particular, seemed to be in perfectly fresh condition. It was well filled with asci containing plump, fresh spores, some of which were uniseptate like those shown in Plate XV, fig. 4. That the fungus was *Leptosphæria coniothyrium* there can be no doubt. Dilution cultures of this perithecium were made in acidulated potato agar. Some of the Leptosphæria spores were seen to germinate, but they became overgrown with other fungi and were lost. Although numerous transfers were made onto plugs of sugar beet none of them produced Coniothyrium. Thus it appears that the fungus was still alive at the end of four years, but the proof is not as conclusive as it would have been had the Coniothyrium been obtained.

Mold on canes, *Botrytis patula* Sacc. & Berl. This fungus has been reported on raspberry canes in New Jersey[49] and Connecticut.[50] On July 22, 1901, the writer found it very abundant at Milton, N. Y., on red raspberry canes from which the fruit had been removed recently. The lower portion of the canes, from the ground upward for a distance of six to twelve inches, was covered with a conspicuous growth of pale yellow or yellowish-white cottony fungus which was most abundant along the longitudinal cracks in the bark. The characteristic features of the fungus are its large, ellipsoidal spores measuring 20 x 30 μ and faintly tinged with yellow; and its coarse, rigid hyphæ branching at right angles. (Plate XV, fig. 2.) Probably, this fungus is only a saprophyte

[49] Kellerman (68).
[50] Clinton (22, p. 274).

and had nothing to do with the death of the canes, which seemed to be due to a severe attack of *Leptosphæria coniothyrium*. In June, 1909, the writer collected *Botrytis patula* on dead currant canes in the same locality.

ROSE.

Rosa spp.

Leaf spot, *Mycosphærella rosigena* (E. & E.) Lindau.[51] In a Geneva greenhouse inspected during January, 1910, there were found several potted hybrid tea roses of one season's growth on which a fungus leaf spot was rather prevalent. The disease first manifests itself as reddish or purplish blotches on the leaves which later develop into sharply defined spots with a purplish border and a dead, brown center. These spots are roundish with somewhat irregular margins and from 2 to 11 mm. in diameter. The dead, brown tissue in the center of the spot is generally freely dotted with black perithecia. Although the perithecia were very plentiful much difficulty was experienced in obtaining ripened specimens. Only a few ripe perithecia were obtained from leaves collected early in January and no better success was had with leaves taken from the same plants the last week in February. However, enough ripe perithecia were obtained for the identification of the fungus which proved to be *Mycosphærella rosigena* (E. & E.) Lindau.[52] The one-year-old plants were considerably more affected than two-year-old plants of the same variety in an adjacent bed. The greenhouse attendant informs us that the disease appears every winter but is never sufficiently abundant to cause serious damage. This may be due to the failure of the spores to ripen in large numbers which in turn may be due to the low temperature of the greenhouse, about 60° F.

Mycosphærella rosigena was first discovered on leaves of cultivated roses from Louisiana[53] and has since been reported by Hal-

[51] By S. M. McMurran.
[52] Host Herbarium Specimen No. 62.
[53] Ellis and Everhart (32).

sted[54] as being of rather common occurrence in New Jersey; but it has not been previously reported from this State.

Powdery mildew. *Sphærotheca pannosa* (Wallr.) Lév. In New York, as elsewhere, roses grown under glass are often severely injured by a powdery mildew which appears only in the conidial stage. The writer has never seen perithecia on mildewed roses under glass. In the absence of perithecia it is usually impossible to identify species of powdery mildew with certainty. Roses in the open air, also, are much subject to mildew and, here, perithecia are sometimes found. However, Salmon holds that roses in America are attacked by two species of powdery mildew, viz., *Sphærotheca pannosa* and *S. humuli,* and that the fungus which has passed here under the name *S. pannosa* is for the most part *S. humuli.* He says,[55] "I have seen only two specimens of true *S. pannosa* from America."

The Station receives numerous complaints of powdery mildew on Crimson Rambler roses. This variety is particularly susceptible. Although the leaves may be severely attacked by mildew it is usually the buds which suffer most. Frequently, the unopened buds are white with mildew before the leaves are affected to any great extent. Affected buds may open and produce flowers of fair quality, but they are likely to be undersized. On Crimson Rambler stems near the tips of the shoots there occur, also, dense patches of white, dirty white or brownish mycelium. In winter, after the leaves have fallen, these patches of mycelium are sometimes conspicuous. In January, 1910, a correspondent at Leeds, N. Y., sent us some mildewed Crimson Rambler stems on which perithecia were abundant. Undoubtedly, the fungus was *Sphærotheca pannosa.* An examination of Crimson Rambler roses on the Station grounds, made about this time, revealed the presence of *Sphærotheca pannosa* perithecia in abundance. Some of the perithecia contained ascospores which were morphologically mature. A rose bush growing on the side of a nearby house, also, showed many perithecia on the stems. Some of these specimens were sent to Dr.

[54] Halsted (53, p. 381).
[55] Salmon (116, p. 69).

Salmon, who identified the fungus as *Sphærotheca pannosa*.[56] In February, 1910, a few perithecia were found in a small patch of mycelium around the base of a prickle on a Crimson Rambler stem from a yard in Geneva. In all of the cases above mentioned the perithecia unquestionably belonged to *S. pannosa*.

Dr. Salmon has made the following statement:[57] "Although *S. pannosa* in its Oidium stage (*O. leucoconium* Desmaz.) often covers the upper surface of rose leaves, I have not been able to find, in the considerable amount of material examined, any perithecia formed here." The writer has seen perithecia, which he believes to be those of *S. pannosa*, on both surfaces of rose leaves. The circumstances were as follows: On the Station grounds there are some bushes of *Rosa humilis* which are shaded during a portion of each day. In the summer of 1910 these roses suffered a mild attack of powdery mildew. As early as August 19th perithecia were numerous on both surfaces of the leaves and many of them contained ascospores.[58] The mildew was confined to the leaves except in one case. In November a single young cane showed small patches of mycelium with imbedded perithecia around the base of each of several prickles. The fungus on this cane was certainly *S. pannosa*. Apparently, the perithecia on the leaves were in no wise different, morphologically, from those on the cane. However, the perithecia on the leaves were free and merely gregarious while those on the cane were closely clustered and imbedded in the mycelium. This difference may be due to difference in habitat. Of course it is possible that the bushes were infested by two species of mildew, but this appears improbable. Figure 90 in Duggar's Fungous Diseases of Plants represents a rose leaf bearing perithecia of *Sphærotheca pannosa*. The specimen from which this illustration was made was taken from the above-mentioned bushes in the autumn of 1907 when perithecia on the leaves were quite as abundant as in 1910.

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[56] Host Herbarium Specimen No. 63.
[57] Salmon (116, p. 67).
[58] Host Herbarium Specimen No. 64.

Fasciation. Fasciated rose canes are not uncommon. The Station museum contains a specimen[59] found in a Geneva nursery by Charles McGuigan, Orchard Foreman at the Station. The fasciated portion is one-half meter long. From the lower end, where it is nearly round and about 10 mm. in diameter, it gradually flattens and widens toward the upper end where the width is 30 mm. Twelve normal round branches spring from near the upper end. The prickles on the fasciated stem are normal. The variety is Dorothy Perkins.

In 1902, August Rahner, a florist of Villisca, Iowa, sent the writer a description and photograph of an exceptionally interesting example of a fasciated rose cane growing on his grounds. In this case the rose was one of the climbing varieties. A certain plant had seven normal canes and one fasciated cane. The fasciated cane was somewhat more than two meters long and had four separate fasciated sections alternating with sections of cane of the normal kind. The fasciated section nearest the root occupied about one-half the entire length of the cane, being 1.16 meters long by 75 millimeters wide. (See Plate XVI.)

RYE.

Secale cereale.

Powdery mildew, *Erysiphe graminis* DC. On June 13, 1910, a field of rye near Geneva was found to be severely attacked by *Erysiphe graminis*. Almost all of the leaves up to a hight of about two feet were thickly covered with the fungus. Many of the leaves were already dead and brown. Perithecia were numerous even on living green or yellowish leaves. They occurred on both surfaces of the leaf but were more numerous on the upper surface. The perithecia contained asci but no ascospores were seen.[60] By July 7th the leaves were all dead and dry, yet there were no ascospores in the perithecia.

A milder attack of *E. graminis* on rye was observed at Oneida on June 22, 1910.

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[59] Museum Specimen No. 140.
[60] Host Herbarium Specimen No. 65.

SNOWBERRY.

Symphoricarpos racemosus.

Anthracnose. *Glœosporium* (?) sp. During the past three years some snowberry bushes growing on the Station grounds have been affected with a disease which disfigures the leaves and berries and sometimes attacks also the new canes. It first came to our attention in the latter part of June, 1908, and continued in evidence throughout the remainder of that season. In 1909 and 1910 it was again observed on the same plants; also, on plants in Smith Park, Geneva, where it was quite destructive. Having been unable to find any published account of such a disease of snowberry, the writer has thought it worth while to give the following description of it even though little is known concerning the systematic position of the causal fungus.

Specimens of the diseased leaves collected July 1, 1908, bore roundish dead spots two to four millimeters in diameter.[61] Occasionally, larger diseased areas were formed by the coalescence of two or more spots. On the upper surface the spots had a gray central area surrounded by a wide brown or black border. Leaves taken from the same plants on September 2, 1908, and September 29, 1909, presented a somewhat different appearance. The spots were now very numerous, many of them being merely gray specks. Most of the larger spots had run together in such manner as to form large irregular areas of brown and gray color. The dark-colored borders of the spots were no longer conspicuous. During August and September the berries show conspicuous brown or black spots which are usually somewhat sunken.[62] Affected berries frequently become misshapen and sometimes shrivel into shapeless brown masses. In July, the young canes may show spots similar to those on the leaves.

The disease is plainly of fungous origin. Microscopic preparations made from scrapings from the upper surface of the leaf spots contain, almost constantly, hyaline, elliptical, non-septate spores

[61] Host Herbarium Specimen No. 66.
[62] Museum Specimen No. 141.

measuring 4 x 6–8 μ. Such spores are more plentiful on leaves collected July 1st than on leaves collected in September. Only the one kind of spores has been found. On berries collected during dry weather no spores could be found until after the berries had been in a moist chamber for 48 hours. Similar difficulty may be experienced in searching for spores on the cane spots. Probably, the fungus is a species of Glœosporium.

According to our observation the disease on the leaves does not seriously affect the growth of the plants. Probably its worst feature is the disfiguration of the berries. The beautiful white berries of the snowberry are its chief attraction.

SWEET PEA.

Lathyrus odoratus

Powdery mildew. Two cases of powdery mildew on sweet peas have come to our attention. In the latter part of August, 1910, a correspondent at Johnsonburg, N. Y., sent specimens accompanied by the statement that he had had the nicest sweet peas in the village until a few days previously when they became diseased and produced but few blooms.

The other case occurred at Geneva in 1910. From the middle of August until the close of the season the plants were completely covered with mildew. It was on leaves (both sides), stems and petioles.[63] A careful search for perithecia was made as late as September 29th, but none were found. Hence the identity of the fungus could not be determined.

No previous record of powdery mildew on sweet peas is known to the writer.

TIMOTHY.

Phleum pratense.

Proliferous flowers. In the warm wet autumn of 1898 the proliferation of timothy flowers was common in New York, particularly in the vicinity of Geneva. In a field of second crop tim-

[63] Host Herbarium Specimen No. 67.

othy on poorly drained clay soil the writer collected a large number of the abnormal heads in a few minutes' time.[64] This was on October 29th. It was observed that the abnormal heads were almost always on shorter stalks than normal heads in the same stool. The leafiness of the affected heads is due to the fact that in each flower the flowering glume or lemma is transformed into a small leaf. This has been described and figured by Beal[65] and also by Toumey.[66]

TOMATO.

Lycopersicum esculentum.

Tomatoes grown in one of the Station greenhouses during the winter of 1909–10 behaved strangely. The plants grew in very rich soil and were given an abundance of water. It is our opinion that the abnormalities described below were, in some way, the consequence of too rapid growth, but the physiological processes by which they were brought about are not clear.

Cracking of stems. About the middle of December several of the plants suddenly developed a deep transverse crack in the stem six to eight inches below the tip of the shoot. At the point of injury the stems were 12 to 15 mm. in diameter. In some cases the crack extended more than half way through the stem. (Plate XVII.) The edges of the crack were nearly as smooth as if the stem had been cut with a knife. On all but three of the plants the wound soon healed so that the leader was not lost.

Leaves and shoots from flower clusters. During January it was a common thing to find the terminal portion of a flower cluster prolonged into a leaf.[67] More often still a leafy shoot developed from this point. In some cases such shoots attained a length of two feet and produced flower clusters of their own. Whether the outgrowth was a shoot or merely a leaf the diameter of its axis was much greater than the diameter of the axis of the

[64] Host Herbarium Specimen No. 68.
[65] Beal (13, p. 37).
[66] Toumey (157).
[67] Host Herbarium Specimen No. 69.

flower cluster from which it sprung. The change in diameter was so great and so sudden as to be very striking.

This is what Masters[68] calls "terminal prolification of the inflorescence." It was most common on plants from seed of the variety Selected Coreless crossed with Earliana, but it occurred, also, on Lorillard and some other varieties. In Bailey's Survival of the Unlike (p. 117) there is a copy of Dunal's figure of *Lycopersicum pyriforme* which shows a flower cluster prolonged into a leafy shoot. This illustrates well the phenomenon described above except that it does not show the change in the diameter of the axis.

Shoots from leaves. On very many of the leaves upright, leafy shoots sprung from the midrib.[69] Often three or four, and sometimes several, shoots appeared on the same leaf. What hight these shoots might have attained is not known since the gardener in charge cut off the most vigorous ones. However, many of them reached a height of 10 to 15 cm. They originated in adventitious buds, invariably on the upper surface of the midrib opposite the point of attachment of lateral leaflets. Sometimes two or three shoots started from the same point.

Probably, this is of the same nature as the case described and illustrated by Ducharte, sixty years ago, in which tomato leaves gave rise to small shoots bearing both leaves and flowers.[70]

VARIEGATED VINCA.

Vinca major.

Wilt, *Phoma* sp. What appears to be an undescribed disease of the variegated vinca was observed in a Batavia greenhouse during December, 1909. The affected plants were in 4-inch pots set along the edge of a carnation bench. Many of the plants had one or more shoots either dead or dying. Some of the dead shoots were already dry while others had only recently wilted. Usually, but

[68] Masters (80, p. 103).
[69] Host Herbarium Specimen No. 70.
[70] Duchartre (26).

not invariably, the shoots were dead from their tips to the surface of the soil. The color of the dead shoots was dark brown except at the surface of the soil where it was usually gray for a distance of 12 to 25 mm. This gray section was thickly studded with small dark-colored bodies which, under a hand lens, were readily recognized as the pycnidia of some fungus. Even on recently wilted shoots the pycnidia were plentiful near the surface of the soil; but they occurred on no other portion of the dead shoots. Plainly, the seat of the trouble was in this gray section of stem at the surface of the soil and the fungus found there was the cause. The fungus proved to be a species of Phoma.[71]

A month later specimens of the same disease were found in a greenhouse at Geneva.

WHEAT.

Triticum vulgare.

Powdery mildew, *Erysiphe graminis* DC. Although wheat in New York is quite frequently attacked by powdery mildew it is probably rare that any serious damage is done. One of the most severe attacks coming to the writer's notice occurred at Geneva in the spring of 1899. In some fields of winter wheat the sheaths and leaf blades were covered with mildew during May and June. Perithecia containing asci (but no ascospores) were plentiful as early as May 23d.[72] Nevertheless, there was a good yield of wheat.

Another severe attack occurred in the spring of 1910. During the latter half of April the trouble became quite general and so conspicuous as to attract considerable attention. On the Station grounds a little mildew was found on winter wheat April 10th. By April 19th so many leaves were attacked that the field appeared quite yellow and it looked as if the crop might be much injured. Although the mildew was followed by a severe attack of rust a yield of about 40 bushels per acre was obtained.

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[71] Host Herbarium Specimen No. 71.
[72] Host Herbarium Specimen No. 72.

On May 5, 1910, a report was received stating that some wheat fields at Baldwinsville had been nearly ruined by mildew. Probably the damage was overestimated.

Stinking smut, *Tilletia fœtens* (B. & C.) Trel. A Brockport farmer estimated that ten per ct. of his wheat crop was ruined by stinking smut. The wheat was of the variety Dawson's Golden Chaff. The specimens of smutted wheat heads which he sent were attacked by *Tilletia fœtens.*

To the unaided eye, the two species of Tilletia occurring on wheat are indistinguishable, but with the aid of a microscope they are readily separated by the markings on the spores. The spores of *T. fœtens* are perfectly smooth while those of *T. tritici* bear conspicuous winged reticulations.

Stinking smut, *Tilletia tritici* (Bjerk.) Wint. In August, 1910, wheat heads affected with stinking smut were received from Perry, N. Y., accompanied by the following statement: "Certain spots have been affected this way for the past ten years and in each rotation the same spots show up and appear to grow larger. I have treated my seed with formaldehyde and with no apparent benefit although the same treatment for smut in my oats has given splendid results."

Upon microscopic examination the smut proved to be *Tilletia tritici.*[73]

Leaf spot, *Septoria graminum* Desm. ? A species of Septoria, probably *S. graminum*, was quite plentiful on leaves of winter wheat on the Station grounds during the second week of April, 1910. Usually, it was found on dead brown leaf-tips which were thickly covered with pycnidia well filled with spores. However, it also occurred on semi-circular, dead brown spots, 5 to 7 mm. in diameter, situated on the margins of green leaves in such manner as to leave little doubt as to its parasitism.[74] In Europe, *S. graminum* is considered a wheat parasite of some importance,[75] but in America it has received only passing notice.

[73] Host Herbarium Specimen No. 73.
[74] Host Herbarium Specimen No. 74.
[75] Mangin (77); Krüger (70).

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